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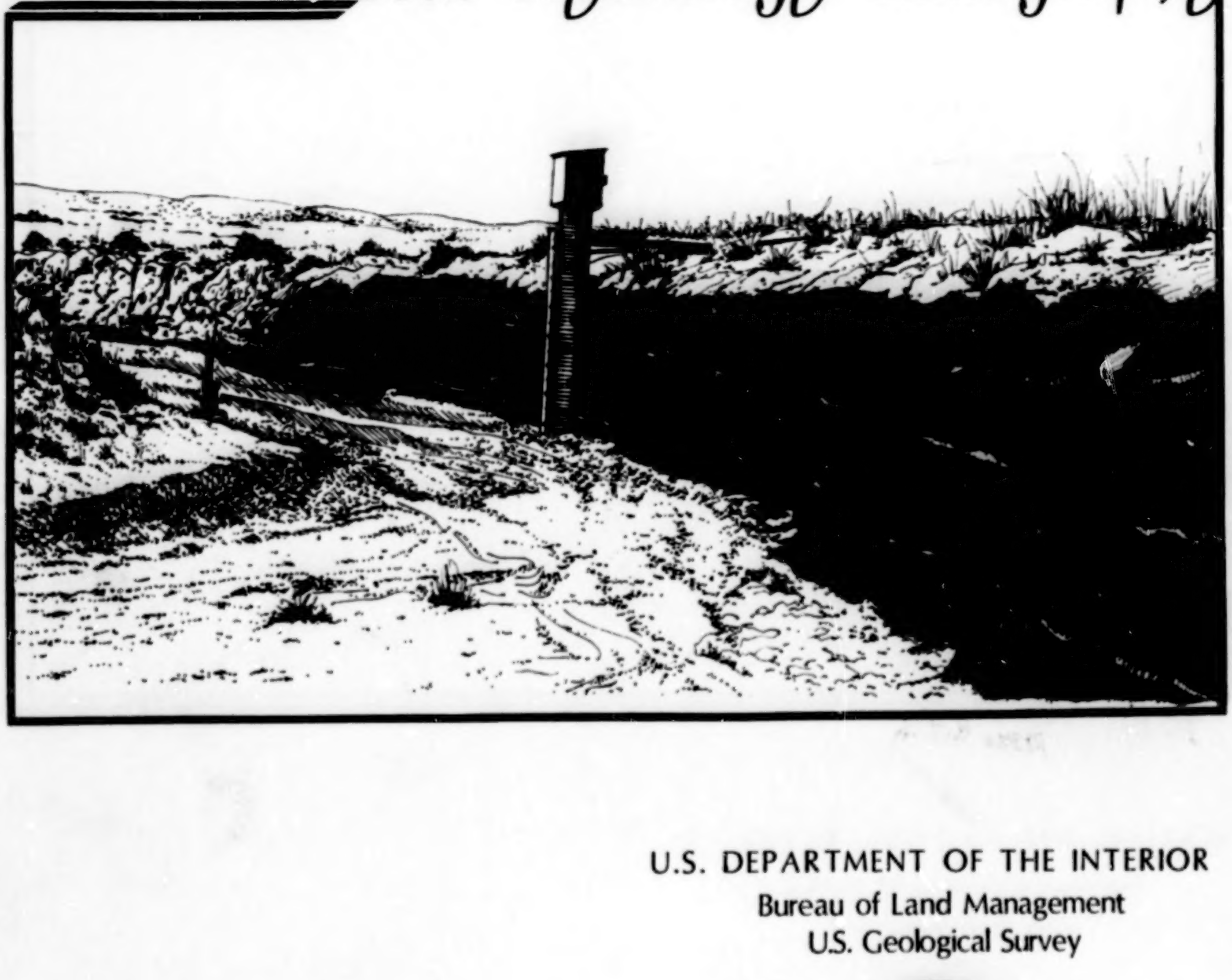
# Coal Hydrology Bibliography



U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management
U.S. Geological Survey

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# COAL HYDROLOGY BIBLIOGRAPHY

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U.S. DEPARTMENT OF THE INTERIOR

Bureau of Land Management
Denver Service Center
Lakewood, Colorado

September 1983

# INTRODUCTION

In 1975 the U.S. Bureau of Land Management and U.S. Geological Survey began cooperative coal-hydrology investigations designed to further knowledge about hydrologic processes and improve Federal coal-leasing decisions affecting water resources. Fiscal Year 1984 marks the 10th year of the program. During those 10 years a large quantity of data have been collected, analyzed, and interpreted. A substantial number of publications resulted from this work.

A decision was made by the two agencies in 1982 to compile a bibliography on coal hydrology. This document is meant to serve as a useful reference for land managers, planners, scientists, and regulatory officials involved with coal leasing and water-resources management.

In compiling this bibliography, Geological Survey publication lists, existing Geological Survey bibliographies, and the Water Resources Scientific Information Center (WRSIC) data base were searched for pertinent Geological Survey publications that contained information relevant to the hydrology of a coal area. The WRSIC abstracts were used unedited as received from the WRSIC data base. Also included are reports of the Energy Mineral Rehabilitation Inventory and Analysis (EMRIA) program, coal leasing environmental impact statements and environmental analysis reports, and Bureau of Land Management land-use planning documents containing information about coal hydrology. Only those documents authored by either the Geological Survey or the Bureau of Land Management are included in this bibliography.

Bibliography entries are organized alphabetically by state. A general list of titles, which did not fit into a specific state section, also is included following the state listings. The bibliography covers all the major Federal coal production regions (fig. 1). A list of common abbreviations used in the references is shown in table 1.

To help meet the need for hydrologic information created by the Surface Mining and Reclamation Act of 1977 (Public Law 95-87), the Geological Survey is in the process of preparing a series of reports that broadly characterize the hydrology of coal areas nationwide. These reports, termed Coal Area Hydrology Reports, are being prepared for the coal areas shown in figures 2a and 2b. The current (1983) status of these reports is shown in table 2.

Publications listed in this document are available from the publishing agency, either the Bureau of Land Management or the Geological Survey.

Bureau of Land Management publications should be requested from the following source:

Division of Resource Systems, D-470
Denver Service Center
Bureau of Land Management
Denver Federal Center, Bldg. 50
Denver, CO 80225

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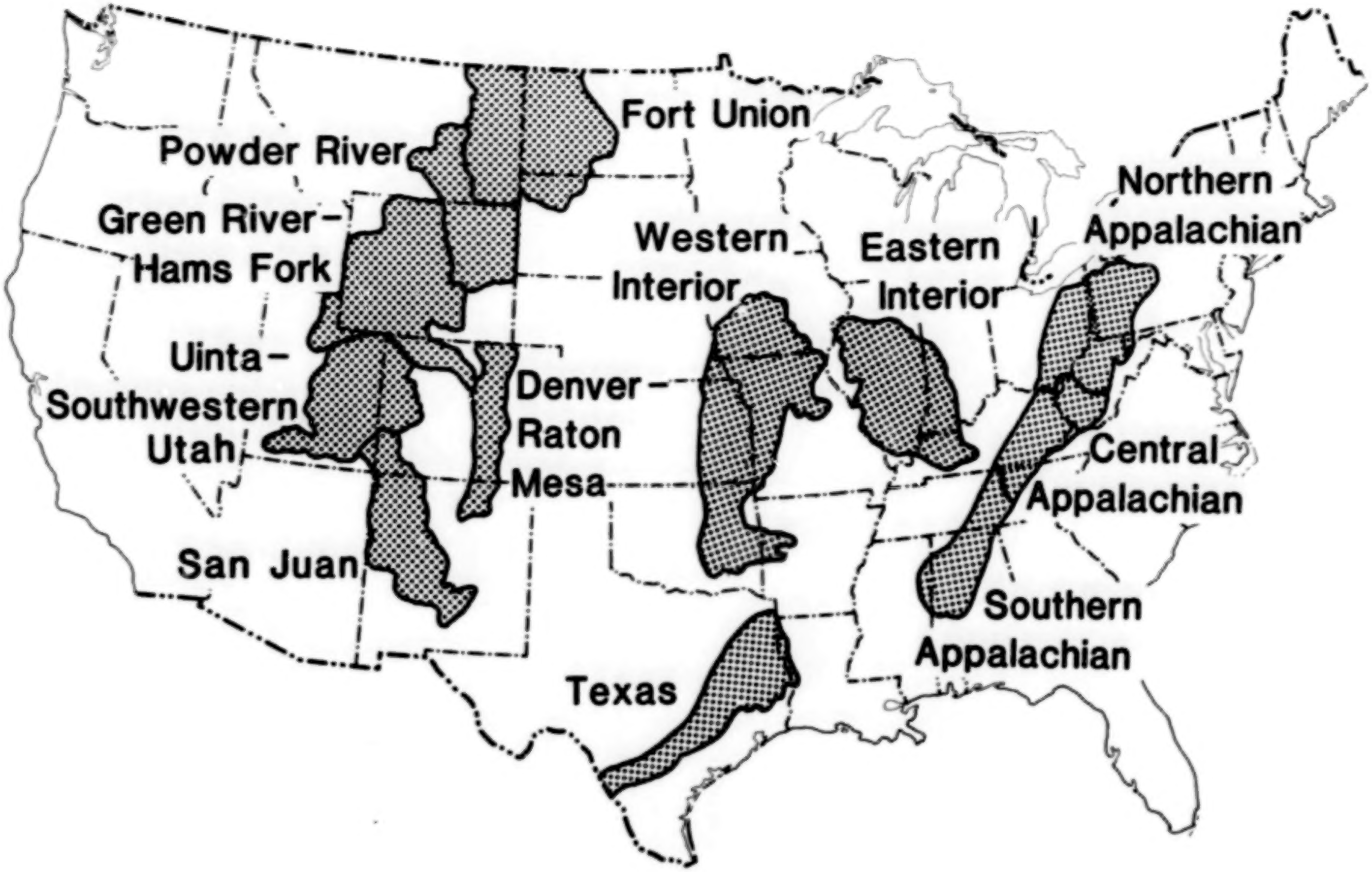

Figure 1.--Federal coal-supply regions in the United States.

Table 1.--Common abbreviations and acronyms used in abstracts.

| | |
|---|---|
| DEA | Draft Environmental Assessment |
| DEAR | Draft Environmental Assessment Record |
| DEIS | Draft Environmental Impact Statement |
| DES | Draft Environmental Statement |
| DTEEA | Draft Technical Examination/Environmental Assessment |
| DTEEAR | Draft Technical Examination/Environmental Assessment Record |
| EA | Environmental Assessment |
| EAR | Environmental Assessment Record |
| EMRIA | Energy Mineral Resource Inventory and Analysis |
| FEA | Final Environmental Assessment |
| FEAR | Final Environmental Assessment Record |
| FEIS | Final Environmental Impact Statement |
| FES | Final Environmental Statement |
| MFP-CA | Management Framework Plan-Coal Amendment |
| SWRA | Selected Water Resources Abstracts |
| TR | Technical Report |

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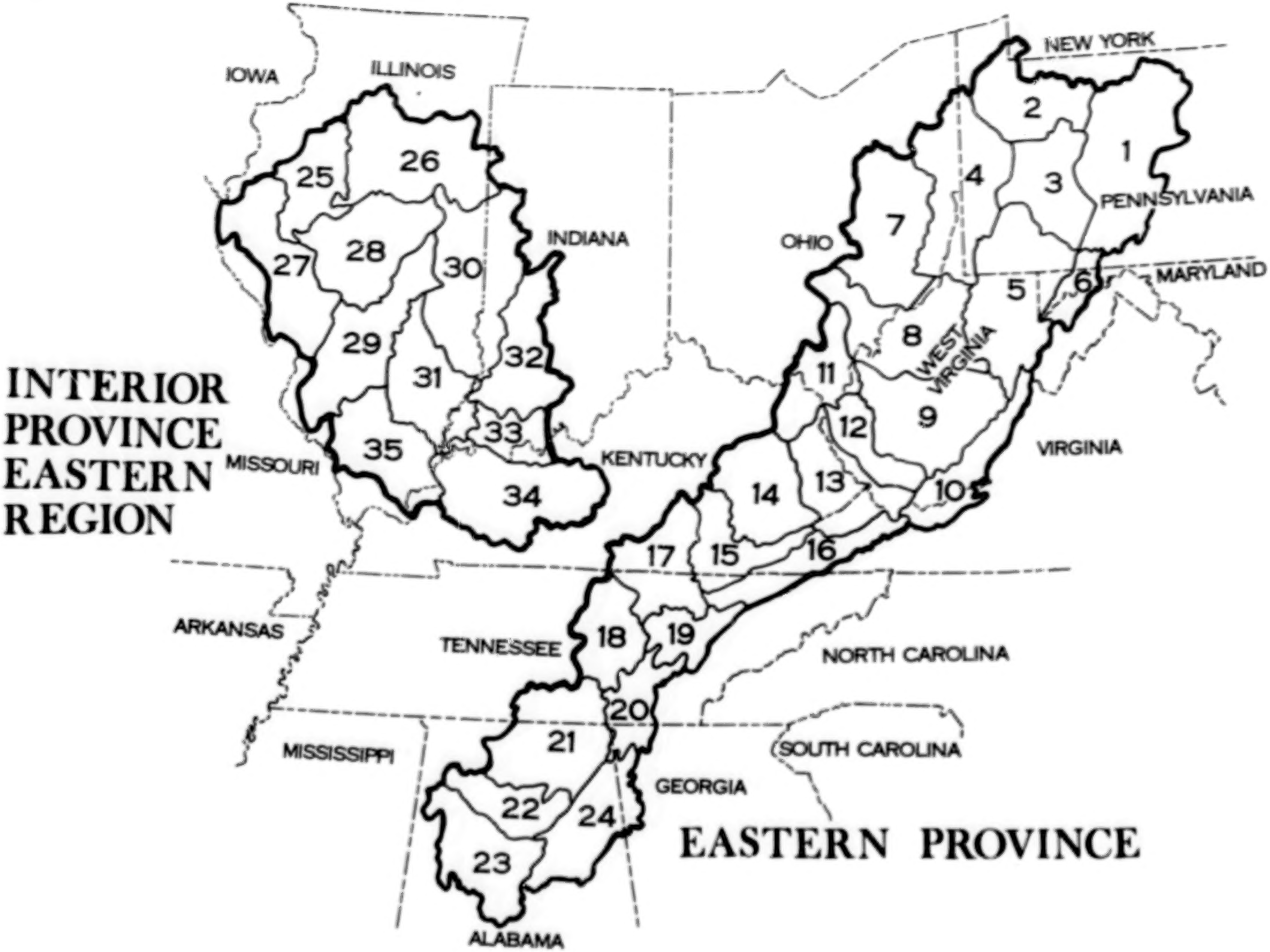

Figure 2a.--U. S. Geological Survey coal areas in the Eastern Interior and Eastern Coal Provinces.

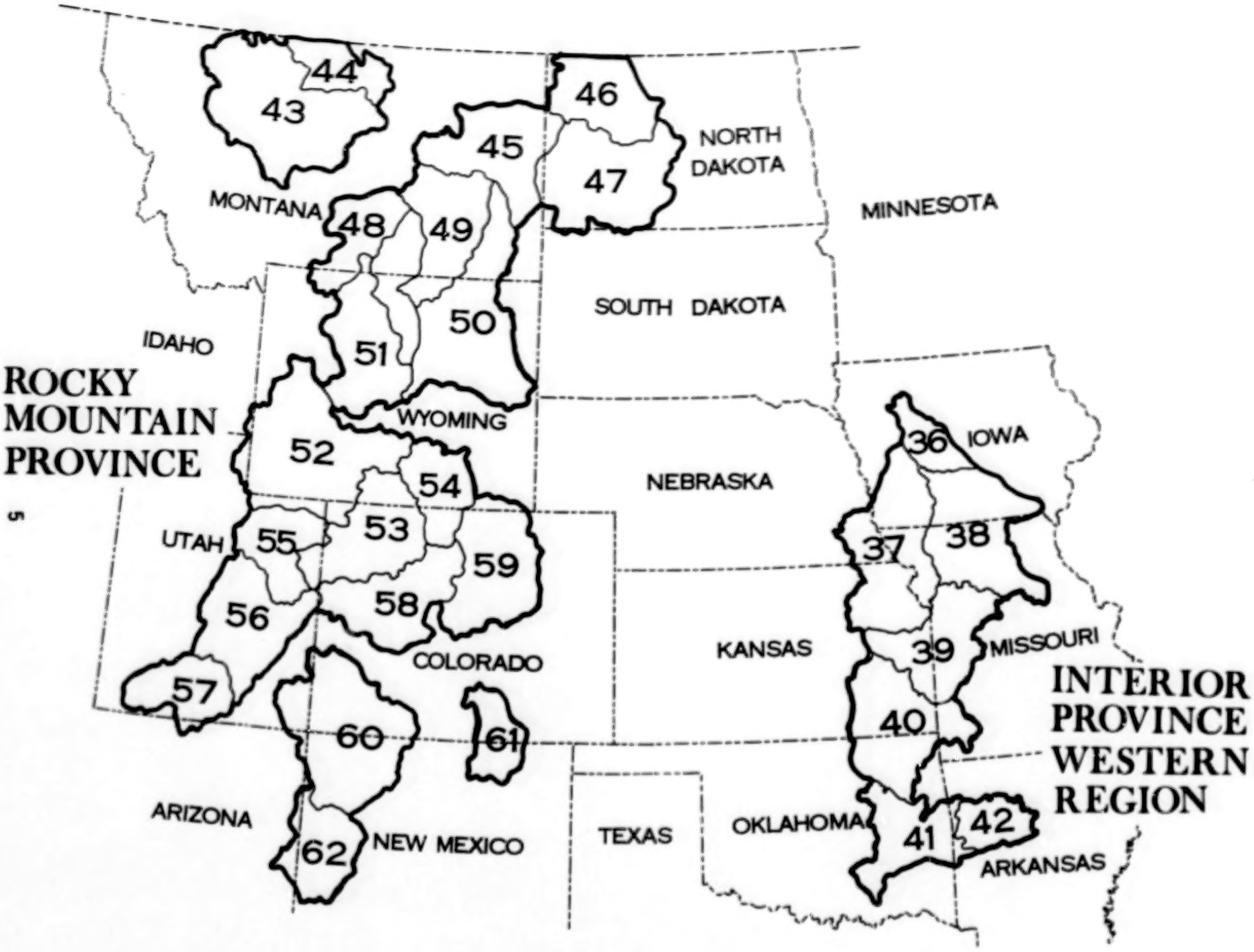

Figure 2b.--U. S. Geological Survey coal areas in the Rocky Mountain and Western Interior Coal Provinces.

Table 2.--Status of U.S. Geological Survey coal area hydrology reports.

| Coal area* | Calendar year report to be published | Water-Resources Investigation, Open-File Report number |
|---|---|---|
| 1 | Published | 82-223 |
| 2 | Published | 82-647 |
| 3 | Published | 81-537 |
| 4 | Published | 81-343 |
| 5 | Published | 81-538 |
| 6 | Published | 83-33 |
| 7 | Published | 81-815 |
| 8 | 1984 | |
| 9 | Published | 81-803 |
| 10 | Published | 82-864 |
| 11 | 1983 | |
| 12 | Published | 81-902 |
| 13 | Published | 82-505 |
| 14 | Published | 81-137 |
| 15 | Published | 81-809 |
| 16 | Published | 81-204 |
| 17 | Published | 81-1118 |
| 18 | Published | 81-492 |
| 19 | Published | 81-901 |
| 20 | Published | 82-440 |
| 21 | Published | 82-679 |
| 22 | Published | 81-135 |
| 23 | Published | 80-693 |
| 24 | Published | 81-1113 |
| 25 | Published | 81-636 |
| 26 | No report planned | |
| 27 | No report planned | |
| 28 | 1983 | |
| 29 | Published | 82-858 |
| 30 | Published | 82-1003 |
| 31 | No report planned | |
| 32 | Published | 81-498 |
| 33 | Published | 81-423 |
| 34 | Published | 82-638 |
| 35 | Published | 81-403 |
| 36 | No report planned | |
| 37 | No report planned | |
| 38 | Published | 82-1014 |
| 39 | 1984 | |
| 40 | 1984 | |
| 41 | 1984 | |

Table 2.--Status of U.S. Geological Survey coal area hydrology reports--Continued.

| Coal area* | Calendar year report to be published | Water-Resources Investigation, Open-File Report number |
|---|---|---|
| 42 | Published | 82-636 |
| 43 | No report planned | |
| 44 | No report planned | |
| 45 | 1983 | 82-527 |
| 46 | 1984 | |
| 47 | 1984 | 83-221 |
| 48 | 1984 | |
| 49 | 1983 | 82-682 |
| 50 | 1984 | |
| 51 | No report planned | |
| 52 | 1984 | |
| 53 | 1984 | |
| 54 | Published | 83-146 |
| 55 | No report planned | |
| 56 | 1983 | 83-38 |
| 57 | 1984 | |
| 58 | 1985 | |
| 59 | 1984 | |
| 60 | Published | 83-203 |
| 61 | 1983 | 83-132 |
| 62 | 1984 | |

*Coal areas, shown in figures 2a and 2b, are delineated on the basis of hydrologic-basin boundaries within the major coal-production regions.

U.S. Geological Survey professional papers, bulletins, water-supply papers, and circulars are obtainable from:

Eastern Distribution Branch, Text Products Section
U.S. Geological Survey,
604 South Pickett St.
Alexandria, VA 22304

U.S. Geological Survey open-file and water-resource investigation reports are available from:

Open-File Services Section (OFSS)
Branch of Distribution
U.S. Geological Survey
Box 25425, Denver Federal Center,
Denver, CO 80225

A Compilation of Ground Water quality data in Alabama
Avrett, James R.
U.S. Geological Survey, Water Resources Division. Geol Surv of Ala Circ 37, 336 p, 1968. 2 Fig, 6 Tab.,
Journal Announcement: SWRA6801

All available data on the quality of ground water in Alabama, up to the date of this report, are tabulated to provide information for appraising water supplies in the state and to determine whether water use is impaired. Water-quality information was obtained by various agencies and individuals in Alabama for many years, but much of the information was not published previously. The chemical and physical character of water, the significance of these properties, and the source of various constituents are discussed. Water quality requirements for domestic, industrial, irrigation, and recreational uses also are described in detail. A total of 3,692 chemical analyses are tabulated in the report, by counties. Radioelement data for 14 sites in the state are compiled in a separate table.

Iron ores, fuels and fluxes of the Birmingham district, Alabama with chapters on The origin of the ores, by E. C. Eckel.
Burchard, E. F., and Butts, Charles, 1910
U.S. Geological Survey Bulletin 400, 204 p.

Section on Fuels and Fluxes (p. 170-188) by Butts describes the stratigraphy and physical properties of the principal coal beds of the Warrior Coal Field. It also contains descriptions of geologic sections for the various coal beds. Coking coal analyses and information on mining methods and coal washing are also included.

Warrior coal basin in the Brookwood quadrangle, Alabama
Butts, Charles, 1905
U.S. Geological Survey Bulletin 260-I, p. 357-381.

Discusses stratigraphy, structure, general mining conditions and developments, and coal groups and analyses.

The Warrior coal basin in the Birmingham quadrangle, Alabama
Butts, Charles, 1906
U.S. Geological Survey Bulletin 285-F, p. 211-222.

Discusses stratigraphy, structure, general mining conditions and developments, and coal groups and analyses.

Description of the Birmingham quadrangle, Alabama
Butts, Charles, 1911
U.S. Geological Survey Geologic Atlas, Folio 175, 24 p.

Description of the Bessemer and Vandiver quadrangles, Alabama
Butts, Charles, 1927
U.S. Geological Survey Geologic Atlas, folio 221, 22 p.

WATER AVAILABILITY AND GEOLOGY IN MARION COUNTY, ALABAMA

CAUSEY, L. V.; WAHL, K. D.; JEFFERSON, P.; HARRIS, W. F. JR
GEOLOGICAL SURVEY OF ALABAMA, UNIVERSITY.
ALABAMA GEOLOGICAL SURVEY MAP 105, 1972. 31 P, 3 FIG, 2 MAPS, 6 TAB, 17 REF.,
Journal Announcement: SWRA0708

ROCKS THAT CROP OUT IN THE EASTERN PART OF MARION COUNTY IN NORTHWEST ALABAMA INCLUDE SANDSTONES AND SHALES OF MISSISSIPPIAN AND PENNSYLVANIAN AGE THAT DIP SOUTHWARD ABOUT 50 FEET PER MILE. THE SANDSTONES ARE POOR AQUIFERS AND EXPECTED YIELDS ARE GENERALLY LESS THAN A QUARTER OF A MILLION GALLONS PER DAY (MGD) PER WELL. THE WESTERN PART OF THE COUNTY IS UNDERLAIN CHIEFLY BY SANDS AND CLAYS OF LATE CRETACEOUS AGE THAT DIP SOUTHWESTWARD ABOUT 25 FEET PER MILE. THE SATURATED SANDS WILL YIELD AS MUCH AS 0.5 MGD PER WELL. STREAMFLOW IS THE PRINCIPAL POTENTIAL SOURCE OF LARGE SUPPLIES OF WATER IN THE COUNTY. THE AVERAGE RUNOFF IS ABOUT 850 MGD. THE DISCHARGE OF THE BUTTAHATCHEE RIVER, THE LARGEST STREAM, AVERAGED 311 MGD AT THE GAGING STATION BELOW HAMILTON DURING 1940-65. THE ANNUAL MINIMUM FLOWS AT THAT STATION RANGED FROM 12 MGD TO 36 MGD DURING THE PERIOD 1951-65 AND THE MEDIAN ANNUAL 7-DAY LOW FLOW WAS 30.4 MGD. WATER FROM SANDSTONE AQUIFERS IS GENERALLY HARD AND HIGH IN IRON CONTENT; WHEREAS WATER FROM UNCONSOLIDATED SAND AQUIFERS IS SOFT AND LOCALLY HIGH IN IRON CONTENT. WATER FROM THE STREAMS IS GENERALLY SOFT AND LOW IN MINERAL CONTENT. ABOUT 1.5 MGD OF WATER IS DEVELOPED FROM AQUIFERS AND LESS THAN 1 MGD IS DEVELOPED FROM STREAMS. (WOODARD-USGS)

Water Availability in Bibb County, Alabama
Causey, L. V.; Willmon, J. R.; Ellard, J. S.
Geological Survey, University, AL. Water Resources Div.
Alabama Geological Survey Map 144, 1978. 16 P., 3 Fig., 2 Plates, 3 Tab.
Journal Announcement: SWRA 1215

The largest sources of water in Bibb County in central Alabama are Limestone, dolomite, and sand aquifers, and Cahaba and Little Cahaba Rivers. Potential sources of 0.5 Mgal/d (million gallons per day) or more per well are limestone and dolomite aquifers in topographic lows in the northern part of the county; limestone and dolomite aquifers in topographic lows and along faults in the central part; and sand aquifers in the southern part. The total average flow of all streams in the county is about 1,260 Mgal/d, of which 590 Mgal/d originates within the county. The Cahaba River at Centreville has an average flow of 1,000 Mgal/d and a 7-day Q2 (median annual 7-day low flow) of about 130 Mgal/d. The Little Cahaba River near Brierfield has an average flow of 130 Mgal/d and a 7-day Q2 of about 30 Mgal/d. Wells in northern and central parts of the county are rarely drilled deeper than 300 feet. Wells in the southern part of the county generally range in depth from 150 feet in the Cahaba River valley to 800 feet in upland areas. Water from aquifers and streams in Bibb County is generally of suitable chemical quality for most uses. Water from sand and sandstone aquifers is generally soft to moderately hard and generally contains iron in excess of 0.3 mg/L (milligrams per liter). Water from limestone and dolomite aquifers is generally moderately hard to hard and has an iron content less than 0.3 mg/L. Water from streams is generally soft to moderately hard and has a dissolved-solids content of less than 150 mg/L. The average use of water in Bibb County in 1969 was about 1.4 Mgal/d which is less than 1 percent of the quantity available. (Woodard-USGS)

Correlation of the Parkwood Formation and the lower members of the Pottsville Formation in Alabama
Culbertson, W. C., 1963
U.S. Geological Survey Professional Paper 450-E, p. 47-50
Describes the correlation of lower members of the Pottsville Formation and redefines the top boundary and extent of the Parkwood Formation. Illustrates columnar sections and their locations.

Geology and coal resources of the coal-bearing rocks of Alabama
Culbertson, W. C., 1964
U.S. Geological Survey Bulletin 1182-B, 79 p.
Estimates coal reserves in Alabama and describes the stratigraphy of the coal-bearing rocks. Includes maps showing the location of coal beds in the Warrior, Cahaba, and Coosa coal fields.

Geology and Water Availability of Cullman County, Alabama
Faust, R. J.; Jefferson, P. O.
Geological Survey, Louisville, KY. Water Resources Div.
Alabama Geological Survey Map 145, 1980. 30 p, 4 Fig, 3 Plates, 3 Tab, 13 Ref.,
Journal Announcement: SWRA1405
The Pottsville Formation of Pennsylvanian age underlies most of Cullman County in northern Alabama. It consists mostly of interbedded sandstones and shales that dip southward about 40 feet per mile. The Bangor Limestone of Mississippian age underlies the Pottsville and crops out in a few valleys along the northern boundary of the county. The principal source of ground water in the county is the Pottsville Formation. Sandstones of the Pottsville Formation underlying low topographic areas will yield as much as 200 gal/min (gallons per minute) to individual wells 200 feet deep or less in the southeastern part of the county and 25-100 gal/min in other parts of the county. Those underlying high topographic areas generally yield less than 5 gal/min. The average flow of streams in and adjoining Cullman County is about 1,500 Mgal/d (million gallons per day) which includes about 760 Mgal/d that originates in the county. Discharge from ground-water storage is small, and most streams cease to flow during extended dry periods. Sipsey Fork and

Mulberry Fork are the only streams in and adjoining Cullman County that have median annual 7-day low flows that exceed 2 Mgal/d. Chemical analyses of water in the county indicate the water is suitable for most uses, but iron concentrations in ground water exceed 0.3 mg/L (milligrams per liter) in many places. Water use in Cullman County was estimated to average 5.6 Mgal/d in 1967. (USGS)

Hydrologic Assessment, Eastern Coal Province Area 23, Alabama
Harkins, J. R.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
Geological Survey Open-File Report 80-683 (WRI), June, 1980. 76 p, 30 Ref, 3 Append.,
Journal Announcement: SWRA1424

The Eastern Coal Province is divided into 24 separate hydrologic reporting areas. The division is based on hydrologic factors, location, size, and mining activity. Hydrologic units (drainage basins) or parts of units are combined to form each area. Area 23 is located at the southern end of the Eastern Coal Province, in the Mobile River basin, includes the Warrior, Cahaba, and edges of the Plateau coal fields in Alabama, and covers an area of 4,716 square miles. It is underlain by the Coker and Pottsville Formations and the pre-Pennsylvanian rocks. The Pottsville Formation contains coal beds and is overlain by the Coker Formation in the western and southern parts of the area. The pre-Pennsylvanian rocks crop out in two northeast-southwest trending belts or ridges along and near the eastern boundary where folding and faulting is common. The outcrop of rocks along the western ridge forms the divide between the Warrior and the Cahaba coal fields. Hydrologic problems relating to surface mining are (1) erosion and sedimentation, (2) decline in ground-water levels, and (3) degradation of water quality. Average annual sediment yields can increase by four magnitudes in surface mined areas from 20 tons per square mile per year from areas not affected by mining to 300,000 tons per square mile per year from mined areas. Sediment yields increase drastically when vegetation is removed from the highly erosive soils and from unregulated surface mining operations. Decline in ground-water levels can occur in and near surface-mining areas when excavation extends below the static water level in the aquifer. (USGS)

Hydrology of area 22, eastern coal province, Alabama
Harkins, Joe R., 1981
U.S. Geological Survey Water Resources Investigations 81-135, 72 p.

Discusses the hydrology of "Area 22", which includes a small part of the Plateau coal field. Sections describe and illustrate water quality and quantity, geology, soils, land use, and data sources. Prepared to provide general information to the coal industry and Federal and State regulatory agencies.

Hydrology of Area 24, Eastern Coal Province, Alabama and Georgia
Harkins, J. R., and others, 1981b
U.S. Geological Survey Water-Resources Investigations Open-File Report 81-1113, U.S. Geological Survey, Tuscaloosa, Ala.
Discusses the hydrology of "Area 24", which includes all of the Coosa coal field and the eastern Part of the Plateau coal field. Sections describe and illustrate water quality and quantity, geology, soils, land use, and data sources. Prepared to provide general information to the coal industry and Federal and State regulatory agencies.

Surface-Water Availability, Etowah County, Alabama
Harkins, J. R.
Geological Survey, Tuscaloosa, Ala.
Alabama Geological Survey Map 108, 1972. 4 Fig, 1 Map, 1 Tab, 12 Red.,
Journal Announcement: SWRA0716
Basic information on the surface-water resources of Etowah County, Alabama, is presented in a map so that a quick visual appraisal of water availability can be made. The streams of Etowah County potentially will provide moderate to large supplies of water for municipal, industrial, and other uses. Two streams, Coosa River and Big Wills Creek, are capable of yielding 10 MGD without storage. With storage, streams draining areas in excess of 10 sq mi have the potential of yielding 10 mgd. Many sites in the county are topographically and geologically suitable for surface reservoirs. Average annual precipitation is 54 inches. Average streamflow is about 1.0 mgd per sq mi. The Coosa River has an average flow of 5,400 MGD where it enters the county and 6,200 MGD where it leaves the county. Water in the county, in general, is relatively low in total dissolved solids, is of good chemical quality, and is suitable for most uses. (KNAPP-USGS)

Surface-Water Availability, St. Clair County, Alabama
Harkins, J. R.
Geological Survey, University, AL. Water Resources Div.
Alabama Geological Survey Map 148, 1980. 10 p, 4 Fig, 1 Tab, 9 Ref.,
Journal Announcement: SWRA1405
The Coosa River, the largest source of water in St. Clair County, Ala., has an average flow of 602 Mgal/d (million gallons per day) where it enters the county and 8,500 Mgal/d where it leaves the county, H. Neely Henry and Logan Martin Reservoirs, which extend along the eastern boundary of the county, have average storage capacities of 132,500 and 359,600 acre feet, respectively. Big Canoe Creek, which flows through the northern part of the county, is the largest stream in the county other

than the Coosa River. It has an average flow of 210 Mgal/d at its confluence with H. Neely Henry Reservoir. Water in streams in St. Clair County is of good chemical quality and is suitable for most uses. Water in Big Canoe Creek is generally soft to moderately hard. Water in the Coosa River is generally soft. (USGS)

Surface-Water Availability, Franklin County, Alabama
Harkins, J. R.; O'Rear, D. M.; Knight, A. L.
Geological Survey, University, Ala.
Alabama Geological Survey Map 106, 1972. 11 P, 5 Fig, 1 Map, 1 Tab, 13 Ref.,
Journal Announcement: SWRA0622

Surface-water resources are described for Franklin County, in northwestern Alabama, in a manner that provides for a quick visual appraisal of surface water availability. The County has moderate relief and is drained primarily by Cedar and Bear Creeks. Streamflow varies considerably from one season to another. Highest monthly flows are 4 to 5 times greater than average monthly flows. Lowest monthly flows are only one-fourth to one-sixth of average flows. The average annual rainfall of 50 inches provides about 700 mgd of average runoff. The addition of 200 mgd via tributaries to Bear Creek results in a total average streamflow of 900 mgd which is about 300 times greater than actual water use in the county. Runoff from the county area is about 1.1 mgd per square mile. The water in streams generally is of a quality suitable for most uses. Cedar Creek, however, contains hard water (145 mg per liter) during periods of low flow. The temperature of water flowing in streams approximates the mean monthly air temperature and generally ranges from 3 deg C in January to 28 deg C during the summer. Temperatures of water from springs remain almost constant (15 to 17 deg C) throughout the year. (WOODARD-USGS)

Description of the Stevenson quadrangle, Alabama-Georgia-Tennessee
Hayes, C. W., 1895
U.S. Geological Survey Geologic Atlas, Folio 19, 8 p.

Description of the Gadsden quadrangle, Alabama
Hayes, C. W., 1896
U.S. Geological Survey Geologic Atlas, Folio 35, 5 p.

The southern Appalachian coal field
Hayes, C. W., 1902
U.S. Geological Survey 22nd Annual Report 1900-1901, pt. 111-e, 227 p.

Hydrology of Area 20, Eastern Coal Province, Tennessee, Georgia, and Alabama, (Duplicated see Tennessee).
Hollyday, E. F., and others, 1982
U.S. Geological Survey Water-Resources Investigations 82-440.

ACID MINE DRAINAGE IN CANE CREEK BASIN, NEAR OAKMAN, WALKER COUNTY, ALABAMA
HYDE, L. W.
GEOLOGICAL SURVEY OF ALABAMA, UNIVERSITY.
GEOLOGICAL SURVEY OF ALABAMA, CIRCULAR 64, 1970, 19P. 7 FIG, 1 TAB, 3 REF.,
Journal Announcement: SWRA0824
ACID DRAINAGE RESULTS FROM THE PASSAGE OF WATER OVER AND THROUGH STRATA OR SPOIL PILES THAT ARE HIGH IN SULFIDE MINERALS. THE OXIDATION OF SULFIDE MINERALS IN THE PRESENCE OF WATER FORMS SULFURIC ACID AND RELEASES ITS PRODUCTS TO NEARBY STREAMS. THE IRON SULFIDE MINERALS ARE GENERALLY ASSOCIATED WITH THE ROCKS ABOVE AND BELOW THE COAL SEAM. CANE CREEK, THROUGHOUT ITS LENGTH OF 14 MILES, CHANGED FROM A NEUTRAL STREAM TO A VERY ACIDIC STREAM, TO A LESS ACIDIC STREAM, AND THEN BACK TO A NEUTRAL STREAM (PH RANGED 8.0 TO 3.0). CLOSE CORRELATION BETWEEN LOW STREAM STAGE AND HIGH PH OF THE WATER WAS FOUND. ACIDIC WATER SHORTENS THE LIFE OF ORDINARY METALS AND CONCRETE USED IN CONSTRUCTION. THE WATER IS NOT SUITABLE FOR MUNICIPAL OR INDUSTRIAL USE WITHOUT EXTENSIVE TREATMENT, AND IS UNSATISFACTORY FOR RECREATIONAL USE. TESTS WERE MADE TO DETERMINE THE RESISTANCE OF MATERIALS USED FOR ROAD CULVERTS TO ACIDIC WATERS. CONTROL OF ACID DRAINAGE IS COMPLEX AND OFTEN ECONOMICALLY IMPRACTICAL. NO SINGLE METHOD HAS BEEN ENTIRELY RELIABLE BUT SEVERAL MEASURES ARE PRESENTED.

Coal deposits on Sand and Lookout Mountains, Dade and Walker Counties, Georgia
Johnson, V. H., 1959
U.S. Geological Survey, Preliminary Map

A Summary of Selected Publications, Project Activities and Data Sources Related to Hydrology in the Warrior and Plateau Coal Fields of Alabama
Kidd, Robert E., and Hill, Thomas J.
U.S. Geological Survey Open-File Report 82-913
The report is a reference source on hydrologic information related to coal-mining activities in the Warrior and Plateau coal fields of Alabama. It contains a bibliography of more than 200 references and selected annotations. Also included is information on maps, automated-data bases, water-monitoring programs, and data-source agencies and organizations.

Water Availability of Jefferson County, Alabama
Knight, A. L.
Geological Survey, Tuscaloosa, Ala. Water Resources Div.
Alabama Geological Survey, University, Map 167, 1976. 31 p, 5 fig, 2 plates, 5 tab, 22 ref.,
Journal Announcement: SWRA1008
The average annual precipitation in Jefferson County, Alabama,

is about 53 inches or about 2,820 mgd (million gallons per day). About 1,130 mgd runs off directly into streams, and the remaining 1,690 mgd replenishes soil moisture to underground reservoirs. Potential sources of ground water are limestone, dolomite, sandstone, and chert aquifers. Wells developed in these aquifers may produce as much as 0.5 mgd per well. In some areas, wells developed in the limestone, dolomite, and chert aquifers may produce more than 0.5 mgd per well. Water from the limestone and dolomite aquifers generally is moderately hard to very hard, contains less than 0.3 mg/liter iron, and has a median value of 150 mg/liter dissolved solids. Water from the sandstone aquifer generally is soft to moderately hard, contains iron in excess of 0.3 mg/liter, and has a median value of 210 mg/liter dissolved solids. Potential sources of surface water in Jefferson County are the Black Warrior and Cahaba Rivers, Locust Fork, and Valley, Village, Fivemile, Shades, and Turkey Creeks. Average flows at the mouth of these streams or at the point where the stream leaves the county are 4,070, 250, 1,230, 360, 100, 120, 100, and 90 mdg. (Woodard-USGS)

Surface-Water Availability, Tuscaloosa County, Alabama
Knight, A. L.; Davis, M. E.
Geological Survey, University, Al. Water Resources Div.; and Geological Survey, Austin, TX. Water Resources Div.
Alabama Geological Survey Map 139, 1980. 12 p, 3 Fig, 1 Tab, 13 Ref.,
Journal Announcement: SWRA1405

The average annual runoff, about 1,270 Mgal/d (million gallons per day), originating in Tuscaloosa County, Ala., is equivalent to 20 inches or 0.95 Mgal/d per square mile. The Black Warrior and Sipsey Rivers, the largest streams in the county, have average flows of 5,230 Mgal/d and 580 Mgal/d, respectively, where they leave the county, and median annual 7-day low flows in excess of 150 Mgal/d and 35 Mgal/d, respectively. North River, Big Sandy Creek, and Hurricane Creek have average flows in excess of 100 Mgal/d and median annual 7-day low flows in excess of 2 Mgal/d. Surface water generally contains less than 100 mg/L (milligrams per liter) dissolved solids, less than 10 mg/L chloride, and is soft to moderately hard. Streams having the higher hardness and the higher dissolved-solids content are in eastern Tuscaloosa County. (USGS)

Water and Related Problems in Coal-Mine Areas of Alabama
Knight, A. L.; Newton, J. G.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
Available from the National Technical Information Service, Springfield, microfiche. Water-Resources Investigations 76-130, April 1977. 51 p, 22 fig, 1 tab, 36 ref.,
Journal Announcement: SWRA1103

Water-resource problems or potential problems in Alabama resulting from surface and subsurface coal mining include erosion and sedimentation, flooding, diversion of drainage, decline in water level, land subsidence, and the degradation of water quality. The degradation of water quality is the most serious and widespread coal-mine related problem in Alabama. The chemical quality of water in numerous streams draining coal-mine areas has been altered drastically. The pH of water draining from mined areas commonly ranges from 2.1 to 5.0, generally has high sulfate and dissolved solids concentrations, is hard to very hard, and may contain objectionable amounts of iron. The detrimental quality of water in some streams may persist for decades after mining has ceased. Without proper safeguards, additional mining may cause a significant deterioration in the quality of water in major streams where the more mineralized mine waters are now diluted. (Woodard-USGS)

Elements of the Water Resources Situation in Alabama
Knowles, D. B.; Barksdale, H. C.
Geological Survey, University, Ala.
Available from NTIS, Springfield, VA 22151 as PB-214 181. Price $3.75 printed copy; $1.45 cents microfiche. December 1969 (revised August 1970). 28 P.,
Journal Announcement SWRA0620

The water-resources situation in Alabama has many facets ranging from water supply to waste disposal, from floods to droughts, and from navigation to recreation. Within this wide range of topics two common elements have been selected for consideration-- factors intimately related to the hydrologic cycle, and significant areas wherein the knowledge and data are inadequate. A discussion of the hydrologic cycle provides a background of understanding. This is followed by a discussion of the types of data and studies that are required for a better understanding of water related problems with recommendations for needed supplemental or additional studies. Most water-resources problems relate in one way or another to the availability of water. Problems of water supply cover much of the water-resources field and are not restricted to the availability of water for domestic, industrial, or agricultural purposes. Under this concept, water for operation of navigational locks, dilution of wastes, launching of a boat or for support of fisheries all become water-supply problems. It is in this broader sense that water-supply problems and the knowledge and data needed for their solution are discussed. (See also W73-12315) (Woodard-USGS)

The map abstract of Water Resources: Alabama
Lineback, N. G.; Peirce, L. B.; Turnage, N. E.
Geological Survey, University, Ala.
Map Abstract No.2, 1974. 105 P, 108 Fig, 14 Ref.,
Journal Announcement: SWRA0802

Water resources data for Alabama were presented in generalized areal form for the entire state. Maps delineating counties, population distribution, physiographic provinces, and river basins were presented. Other maps indicated the variability of temperature, precipitation, lake evaporation, runoff, low flow, and areal distributions of groundwater availability and major aquifers. Areal patterns of water use from ground and surface water sources for public water supplies, agriculture, agriculture, industry, cooling water, and of the variation in physical and chemical characteristics of ground and surface waters were presented. (Humphreys-ISWS)

Geology and mineral resources of the Region, in Schneider, W. J., and others, Water Resources of the Appalachian Region, Pennsylvania to Alabama
Meyer, Gerald, 1965
U.S. Geological Survey Hydrologic Investigations Atlas HA-198, Sheet 3.
Geologic map (1:2,500,000) of the Appalachian Region including north-central Alabama. Also gives a brief discussion of water-supply and lithologic characteristics of rock types. Locations of coal, oil, and gas regions are shown.

Availability of ground water in the Appalachian Region, in Schneider, W. J., and others, water resources of the Appalachian Region, Pennsylvania to Alabama
Meyer, Gerald, Wilmoth, B. M., and LeGrand, H. E., 1965
U.S. Geological Survey Hydrologic Investigations Atlas HA-198, Sheet 10
Map shows least- to most-favorable areas for development of large ground-water supplies, including localities of high production (100 gallons per minute or more). Includes general discussion of ground-water availability.

ENVIRONMENTAL GEOLOGY--AN AID TO GROWTH AND DEVELOPMENT IN LAUDERDALE, COLBERT AND FRANKLIN COUNTIES, ALABAMA
MOSER, P. H.; HYDE, L. W.
GEOLOGICAL SURVEY OF ALABAMA, UNIVERSITY. ENVIRONMENTAL DIV.
ATLAS SERIES 6, 1974. 45 P, 25 FIG, 1 TAB, 63 REF, 72 PHOTO.,
Journal Announcement: SWRA0817
A PICTORIAL AND GRAPHICAL PRESENTATION OF LAUDERDALE, COLBERT, AND FRANKLIN COUNTIES IN NORTHWESTERN ALABAMA WAS PRESENTED IN CONJUNCTION WITH AN EXPLANATORY TEXT AND TABULAR DATA ON THE GEOLOGY, WATER AND MINERAL RESOURCES, ENGINEERING GEOLOGY, AND ASSOCIATED FACTORS. THESE ARE TO BE USED BY PLANNERS AND DEVELOPERS FOR IMPLEMENTING IMMEDIATE AND LONG-RANGE PLANS FOR THE EFFECTIVE AND ORDERLY DEVELOPMENT OF THE AREA. (SCOTT-ISWS)

ENVIRONMENTAL GEOLOGY OF AN AREA IN WEST-CENTRAL ALABAMA
MOSER, P. H.; KEENER, M. J.
GEOLOGICAL SURVEY OF ALABAMA, UNIVERSITY. ENVIRONMENTAL DIV.
ATLAS SERIES 7, 1975. 56 P, 52 FIG, 101 REF, 54 PHOTO. HUD GRANT P-1020, P-1042.,
Journal Announcement: SWRA0819
THE ENVIRONMENTAL DATA NECESSARY TO PLAN FOR DEVELOPMENT

BROUGHT ON BY THE CONSTRUCTION OF THE TENNESSEE-TOMBIGBEE WATERWAY WERE PRESENTED. THE STUDY AREA INCLUDES ALL OF SUMTER COUNTY AND THOSE PARTS OF GREENE AND PICKENS COUNTIES ADJACENT TO THE TOMBIGBEE RIVER. LAND USE IS NOT LIMITED TO CROPS, PASTURE, FOREST, AND RELATED INDUSTRIES. SUBSTANTIAL SUPPLIES OF SURFACE WATER AND GROUNDWATER ARE AVAILABLE AND SHOULD ENCOURAGE ECONOMIC DEVELOPMENT. SAND AND GRAVEL ARE AVAILABLE FOR CONSTRUCTION; ABUNDANT CHALK AND CLAY ARE AVAILABLE FOR USE AS LIGHWEIGHT AGGREGATE. ENERGY SOURCES IN THIS AREA HAVE NOT BEEN FULLY DEVELOPED. A COAL-FIRED STREAM PLANT PROVIDES ELECTRICITY TO SURROUNDING AREAS AND A NARROW BAND OF LIGNITE THAT HAS NOT BEEN DEVELOPED OCCURS IN SUMTER COUNTY. THIS AREA HAS THE POTENTIAL TO BECOME MORE PRODUCTIVE; THEREFORE, INFORMATION WAS PROVIDED ON THE AREA'S POSITIVE CHARACTERISTICS AND ITS LIMITING FACTORS WERE ENUMERATED SO THAT DEVELOPMENT WILL BE ACCOMPLISHED IN AN ORDERLY AND EFFICIENT MANNER. (SCOTT-ISWS)

Environmental Geology as an aid to Urban and Industrial Growth in Northwest Alabama
Moser, Paul H.
Alabama State Geological Survey, Tuscaloosa.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), P 392-398.,
Journal Announcement: SWRA0317

With population increases in this country, Urban and Industrial expansion is anticipated as being quite dramatic. The role of environmental geology in contributing to the necessary planning is discussed with attention directed toward expansion corridors in northwest Alabama. The Results of the investigations are envisioned as furnishing planners with a comprehensive, detailed, practical study, which can be used to stimulate and then maintain an orderly urban and industrial growth. Lauderdale, Colbert, and Franklin Counties were the site of the first environmental investigation, A brief outline of which is included. Information concerns hydrology, associated resources, geology and engineering geology. Quantities of potential surface and groundwater are mentioned, and discussion is given to the quality (expressed in amounts of dissolved solids). The urban nucleus, the muscle shoals area, is briefly described in terms of population concentration. Three roughly drawn areas are seen from a geological and physiographical viewpoint, and detailed geologic maps are indicated as being available and extremely valuable in planning. In the muscle shoals area, it is concluded, 80 per cent of the slopes are gentle enough to present no difficulties for any type of planning. Finally, the importance of engineering capacity is discussed. The bearing capacity of the soil is mentioned because it determines types and sizes of footings necessary for various kinds of construction. Mentioned also in this regard is consideration of flood plains, drainage, soil classifications, mapping of sink holes, and soil thickness.

(Preckwinkle-Chicago)

Acid mine drainage in the Appalachian Region, in Schneider, W. J., and others, Water Resources in the Appalachian Region, Pennsylvania to Alabama
Musser, J. J., 1965
U.S. Geological Survey Hydrologic Investigations Atlas HA-198, Sheet 9.
Gives brief discussion of acid mine drainage. Map shows coal fields and two categories of streams: Those containing free mineral acid and acid-producing salts, and those influenced by mine drainage but seldom containing free acid or acid-producing salts.

WATER AVAILABILITY OF MARENGO COUNTY, ALABAMA
NEWTON, J. G.; MCCAIN, J. F.; KNIGHT, A. L.
GEOLOGICAL SURVEY, TUSCALOOSA, ALA.
ALABAMA GEOLOGICAL SURVEY MAP 98, 1971. 21 P, 3 FIG, 1 MAP, 4 TAB, 17 REF.,
Journal Announcement: SWRA0510
LARGE SUPPLIES OF WATER ARE AVAILABLE FOR USE IN MARENGO COUNTY, ALABAMA. OF THE AVERAGE ANNUAL RAINFALL OF ABOUT 52 INCHES, 17 INCHES RUNS OFF AS STREAMFLOW. TOTAL RUNOFF IS 890,000 ACRE FEET PER YEAR OR AN AVERAGE OF ABOUT 0.8 MGD PER SQUARE MILE. THE PRINCIPAL SOURCES OF GROUNDWATER ARE THE EUTAW FORMATION IN THE NORTHERN PART OF THE COUNTY AND THE TUSCAHOMA SAND AND NANAFALIA FORMATION IN THE SOUTHERN PART. THE EUTAW WILL YIELD 1 MGD PER WELL AND THE TUSCAHOMA AND NANAFALIA 0.1 TO 0.5 MGD PER WELL. IN NORTHWESTERN AND SOUTH-CENTRAL PARTS OF THE COUNTY, WATER IN AQUIFERS IS HIGHLY MINERALIZED, HAVING A CHLORIDE CONTENT THAT EXCEEDS 1,000 MG/L. THE PRINCIPAL STREAMS IN THE COUNTY ARE THE BLACK WARRIOR AND TOMBIGBEE RIVERS. AT THEIR JUNCTION IN THE NORTHERN PART OF THE COUNTY, THE AVERAGE DISCHARGE OF THE TOMBIGBEE IS 7,800 MGD AND THE BLACK WARRIOR 6,270 MGD. WATER IN THE STREAMS IS SOFT TO MODERATELY HARD AND GENERALLY HAS A DISSOLVED SOLIDS CONTENT OF LESS THAN 125 MG/L. (WOODARD-USGS)

Water Availability and Geology of Walker County, Alabama
O'Rear, D. M.; Wahl, K. D.; Jefferson, P. O.
Geological Survey, Tuscaloosa, Ala.
Alabama Geological Survey, University, Map 120, 1972. 21 P, 3 Fig, 2 Plate, 5 Tab, 12 Ref.,
Journal Announcement: SWRA0815
The largest quantities of groundwater in Walker County, Alabama are obtained from sandstone beds in the Pottsville Formation, which generally yield less than 50 gallons per minute to individual wells. The water from the Pottsville ranges from soft to very hard, and is suitable for most uses except locally where the iron and bicarbonate concentrations may be objectionable or

where the water is excessively hard. The coker formation is tapped by only a few wells in the country, and the alluvium in the flood plain of the Mulberry Fork of the Black Warrior River provides a limited amount of water to only a few wells. The water is generally reported to be soft and satisfactory for domestic use. Parts of two large reservoirs are in Walker County--Lewis Smith Lake, with a total storage of 1,670,700 acre-feet, and Bankhead Reservoir, with a total storage of 94,100 acre-feet. Blackwater Creek near Manchester has an average flow of 196 mgd. The chemical quality of water in streams in Walker County is relatively uniform and the water should be suitable for most uses. Water use in Walker County was estimated to be 6 mgd in 1966. Groundwater sources are estimated to supply about 15 percent of the water used in the county. (Knapp-Usgs)

Flood Frequency of Small Streams in Alabama
Olin, D. A.; Bingham, R. H.
Geological Survey, University, AL. Water Resources Div.
Alabama Highway Department HPR No. 83, August 1977. 44 p, 12 fig, 1 tab, 10 ref.,
Journal Announcement: SWRA1209

Equations have been developed for estimating future floods for 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals on natural streams in Alabama with drainage areas of 1 to 15 square miles. One equation for each recurrence interval applies statewide. The equations were developed by multiple regression analysis of flood magnitudes obtained from both observed peak discharges and synthetic discharge data generated with a calibrated rainfall-runoff model, and physical basin characteristics. The regression analysis indicated that drainage area and main channel slope are the most significant basin characteristics affecting flood frequency and magnitude. Those characteristics can generally be determined from topographic maps. (Woodard-USGS)

Effect of Surface Coal Mining on the Hydrology of Crooked and Turkey Creek Basins, Jefferson County, Alabama
Puene, C.; Newton, J. G.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
Geological Survey Water-Resources Investigations 79-91, August 1979. 39 p, 18 Fig, 5 Tab, 21 Ref.,
Journal Announcement: SWRA1320

Streamflow, sediment yield, and water quality were monitored from October 1975 through May 1977 to determine the impact of surface coal mining on the hydrology of Crooked and Turkey Creek basins in Jefferson County, Alabama. The basins are in the northeast part of the Warrior coal field. Coal is and has been mined from the Blue Creek, Mary Lee, and Newcastel coal beds in the Mary Lee group. Results show water-quality degradation, increased sediment yields, and increased low flow in most tributaries draining mined areas. The impact of mine drainage and sediment yield from mined subbasins on water in the main stem of Turkey Creek was small due to the alkalinity of the water in the creek and to dilution ratios that ranged from 1:30 to 1:300. Mine drainage has affected the quality of water in Crooked Creek. The dissolved solids concentration in water downstream from the mined areas was as much as 7 times greater than that in water in unmined parts of the basin. The sediment yield to Crooked Creek was lower in the mined area than in the unmined segment of the stream. The lower yield is due, in part, to the trapping of sediment in sediment ponds in the mines and in a swamp downstream from the mines. (USGS)

Hydrology of Selected Basins in the Warrior Coal Field, Alabama--A Progress Report

Puente, C.; Newton, J. G.; Hill, T. J.

Geological Survey, Tuscaloosa, AL. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-104754, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-22, March, 1980. 62 p, 18 Fig, 20 Tab, 23 Ref.,

Journal Announcement: SWRA1411

Hydrologic data are being collected in four basins in the Warrior coal field in Alabama to provide baseline information to aid in determining the effect mining will have on water resources. Basins monitored are in two different geologic and hydrologic environments. Two basins are underlain predominantly by relatively impermeable indurated rocks in the Pottsville Formation of Pennsylvanian age. The two remaining basins are underlain predominantly by unconsolidated permeable rocks in the Coker Formation of Late Cretaceous age. Well yields from the Pottsville Formation generally range from 0 to 0.3 liter per second, whereas well yields from the Coker Formation generally range form 0.3 to 6.4 liters per second. Streamflow distribution reflects seasonal precipitation. Storm runoff is characterized by sharply concentrated flows of short duration that rapidly recede to low-flow conditions. Streams draining basins underlain chiefly by the Pottsville Formation frequently go dry, whereas those draining basins underlain chiefly by the Coker Formation have well sustained low flows. Water in the Pottsville Formation is slightly acidic and moderately hard to very hard. Dissolved solids concentrations ranged from 176 to 268 milligrams per liter. Water in the Coker Formation is soft, far less mineralized, and more acidic than water in the Pottsville. Surface water is generally soft, acidic and low in dissolved solids concentrations. Water in streams draining basins underlain chiefly by the Pottsville Formation was slightly more mineralized and less acidic than water in streams draining the Coker Formation. (USGS)

Hydrology of potential mining areas in the Warrior Coal Field, Alabama
Puente, Celso, and Newton, J. G., 1981
U.S. Geological Survey Water-Resources Investigations, Open-File Report 82-105, U.S. Geological Survey, Tuscaloosa, Ala.

Assessment of hydrologic conditions in potential coal-lease tracts in the Warrior coal field, Alabama
Puente, Celso, Newton, J. G., and Bingham, R. H., 1981
U.S. Geological Survey Water-Resources Investigations 81-540, 65 p.
The hydrology of four potential coal-lease tracts in the Pottsville Formation are assessed. Local and regional data are used to describe streamflow characteristics, surface-water quality, and ground-water availability and quality. Climatic, physiographic, hydrologic, and land-use data were analyzed by regressions to derive estimates of specific conductance and other constituents such as hardness, dissolved solids, and sulfate loads. Impacts that will result from future mining are defined, and methods used to estimate these impacts on surface water quality are described.

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia. (Duplicated see Ohio, Tennessee, and West Virginia)
Roth, D. K., Engelke, M. J. Jr., and Others, 1981
Columbus, Ohio, U.S. Geological Survey Open-File Report 81-343, 62 p.

Water Availability, Shelby County, Alabama
Shamburger, V. M.; Harkins, J. R.
Geological Survey of Alabama, University.
Alabama Geological Survey Map 140, 1980. 32 p, 3 Fig, 3 Tab, 15 Ref.,
Journal Announcement: SWRA1405
The largest sources of ground water in Shelby County, Ala., are limestone and dolomite aquifers which are potential sources of about 0.5 Mgal/d (million gallons per day) per well. The most favorable well sites are in valleys or low topographic areas and adjacent to faults. Yields of wells rarely increase at depths greater than 350 feet except in fractured zones along faults. The major sources of surface water are the Coosa and Cahaba Rivers. The Coosa River is impounded by Lay Dam, which forms a lake of 145,000 acre-feet of water at elevation 396 feet above mean sea level. The Coosa and Cahaba Rivers have average flows of 9,400 Mgal/d and 400 Mgal/d, respectively at their lower reaches in the county. The Coosa River will provide more than 1,000 Mgal/d; whereas, the Cahaba River, Shoal Creek, and Buck Creek along their lower reaches in the county are each capable of providing water at the rate of 10 Mgal/d or more without storage. The county has an average annual precipitation of 54 inches of

which about 20 inches runs off in streams. The 20 inches of runoff is equivalent to 800 Mgal/d or 1.0 Mgal/d per square mile. Ground water is of suitable chemical quality for most uses, but water from some sources may be objectionable for certain uses because of hardness or iron content. Surface water is of suitable chemical quality for most uses. Water use in the county in 1969 was estimated to be 5.6 Mgal/d, which is insignificant when compared to the total available supply. (USGS)

Methodology for Hydrologic Evaluation of a potential surface mine
Shown, L. M., and Others, 1982
Loblolly branch basin, Tuscaloosa County, Alabama. 93 P. WRD 82-50.

WATER RESOURCES AND GEOLOGY OF WINSTON COUNTY, ALABAMA
WAHL, K. D.; HARRIS, W. F.; JEFFERSON, P. O.
GEOLOGICAL SURVEY, UNIVERSITY, ALA.
ALABAMA GEOLOGICAL SURVEY BULLETIN 97, 1971. 51 P, 10 FIG, 6 PLATE, 7 TAB, 23 REF.,
Journal Announcement: SWRA0519
WATER RESOURCES DATA FOR WINSTON COUNTY, ALABAMA, SHOW QUANTITY AND QUALITY OF SURFACE AND GROUNDWATERS AS RELATED TO THE GEOLOGY AND WATER USE. THE BANGOR LIMESTONE AND THE POTTSVILLE FORMATION ARE THE TWO MAJOR SOURCES OF GROUNDWATER. THE BANGOR LIMESTONE CONSISTS OF ABOUT 400 TO 550 FEET OF LIMESTONE AND SHALE. WATER-BEARING OPENINGS OCCUR PRIMARILY IN THE UPPER 25 TO 50 FEET, WHICH IS A POTENTIAL SOURCE OF 25 TO 50 GPM. WATER FROM THE BANGOR GENERALLY IS MODERATELY HARD TO HARD AND LOW IN IRON CONTENT. THE POTTSVILLE FORMATION CONSISTS OF 1,200 FEET OF SANDSTONE, SHALE, AND COAL. INDIVIDUAL WELLS PRODUCE FROM LESS THAN 5 TO ABOUT 375 GPM. THE WATER RANGES FROM SOFT TO HARD AND IS OF GOOD CHEMICAL QUALITY EXCEPT IN PLACES WHERE THE IRON CONTENT MAY BE OBJECTIONABLE. MOST OF THE STREAMS DRAINING WINSTON COUNTY ORIGINATE WITHIN THE COUNTY. THE AVERAGE FLOW INTO LEWIS SMITH LAKE IS APPROXIMATELY 670 MGD. SIPSEY FORK, THE LARGEST STREAM, HAD A MAXIMUM RECORDED FLOW OF 48,400 CFS NEAR FALLS CITY. THE TOTAL USE OF WATER IN WINSTON COUNTY DURING A PEAK DEMAND PERIOD WAS ABOUT 1.2 MGD IN 1965. GROUNDWATER SOURCES SUPPLY ABOUT 75% OF THE WATER AND SURFACE WATER SOURCES ABOUT 25%. (WOODARD-USGS)

GEOLOGIC MAP OF WALKER COUNTY, ALABAMA
WAHL, K. D.; O'REAR, D. M.
GEOLOGICAL SURVEY, TUSCALOOSA, ALA.
ALABAMA GEOLOGICAL SURVEY, UNIVERSITY, MAP 123, 1972. 1 SHEET.,
Journal Announcement: SWRA0815
THE GEOLOGY OF WALKER COUNTY, ALABAMA IS SHOWN ON A MAP SCALED ABOUT 2 MILES TO 1 INCH. THE ENTIRE COUNTY IS UNDERLAIN BY THE POTTSVILLE FORMATION OF PENNSYLVANIAN AGE. THERE ARE A FEW OUTCROPS OF THE COKER FORMATION OF CRETACEOUS AGE IN THE

NORTHWEST PART OF THE COUNTY. STREAM VALLEYS HAVE TERRACE DEPOSITS AND ALLUVIUM. THE POTTSVILLE FORMATION, THE PRINCIPA.L AQUIFER IN THE COUNTY, IS 1,000 TO 3,000 FEET THICK AND CONSISTS CHIEFLY OF SANDSTONE AND SHALE. THE POTTSVILLE ALSO CONTAINS BEDS OF COAL WHICH HAVE BEEN MINED THROUGHOUT THE COUNTY. (KNAPP-USGS)

Sediment load of streams in the region, in Schneider, W. J., and Others, Water Resources of the Appalachian Region, Pennsylvania and Alabama
Wark, J. W., 1965
U.S. Geological Survey Hydrologic Investigations Atlas 198, Sheet 8.
Map showing average annual sediment yield in tons per square mile for north-central Alabama and other regions. Includes brief discussion of sediment load in streams.

MINERALS AND WATER, BUTLER COUNTY, ALABAMA
GEOLOGICAL SURVEY OF ALABAMA, UNIVERSITY, ALA.
GEOL SURV OF ALA INFORM SER 36, 37 P, 1967. 5 TAB, 12 REF.,
Journal Announcement: SWRA6804
THE WATER RESOURCES OF BUTLER COUNTY, ALABAMA ARE DESCRIBED AS PART OF A REPORT ON THE GEOLOGY, MINERAL RESOURCES, AND WATER RESOURCES OF THE COUNTY. GROUNDWATER EVALUATION IS BASED ON RECORDS OF 188 WELLS AND 1 SPRING. THE PRINCIPAL AQUIFERS ARE SAND BEDS IN THE EUTAW, RIPLEY, AND NANAFALIA FORMATIONS, AND LIMESTONE BEDS IN THE CLAYTON FORMATION, OF UPPER CRETACEOUS TO CENOZIC AGE. A MAP AND CROSS SECTION INDICATE MAXIMUM DEPTHS NECESSARY FOR WELLS THAT WILL PRODUCE 0.5 MGD; DEPTHS NEEDED FOR DOMESTIC WELLS ARE ALSO MAPPED. WATER FROM THE RIPLEY FORMATION IS GENERALLY SOFT, AND WATER FROM THE OTHER AQUIFERS RANGES FROM SOFT TO HARD. CHLORIDE, IRON, AND HARDNESS CONTENTS ARE SHOWN ON MAPS. AVERAGE RUNOFF IS 19 IN. OR 0.9 MGD PER SQ MI. MANY OF THE STREAMS IN THE WESTERN PART OF THE COUNTY ARE INTERMITTENT. IN THE NORTHWEST THE WATER IS MODERATELY HARD DURING FLOOD FLOW AND HARD DURING LOW FLOW. IN THE EAST THE WATER IS SOFT DURING FLOOD FLOW AND MODERATELY HARD DURING LOW FLOW. IN OTHER PARTS OF THE COUNTY SURFACE WATER IS SOFT. ALL STREAM WATER HAS LESS THAN 15 PPM CONTENT CHLORIDES. (KNAPP-USGS)

Water Resources Data for Alabama, Published annually since 1975.
Geological Survey, Univ., Al. Water Resources Div.
Water resources data for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)

Southern Appalachian Coal Region, Alabama
BLM, Alexandria, Virginia
DEIS, 1980

This statement assesses impacts of leasing a maximum of 78.27 million tons of marketable Federal coal in 26 tracts in Fayette, Tuscaloosa and Walker Counties, northwest-central Alabama. The coal is in the nearly flat-lying Pennsylvanian Pottsville Formation in the broad, dissected Warrior Coal Field plateau in the Warrior Synclinal Basin. Most tracts are in 1- to 5-mile-square headwater areas of intermittent streams that have eroded steep-sided gorge-like valleys into the plateau, leaving nearly level bottoms between narrow flat ridgetops. Annual runoff is 18 to 24 inches from about 54 inches of annual precipitation. Most of the Federal coal would be mined underground at great enough (500 to 1,200 feet) depths to eliminate subsidence. Underground mining would impact about 38,000 acres of potential coal aquifers in addition to the 150,000 acres being, or to be, disturbed by mining of non-Federal coal. Surface mining of the remainder of the Federal coal would impact about 18,000 acres of near surface aquifers. Within, or near the tracts, 164 wells obtaining small quantities of good quality water from poor aquifers above the coal would be prone to removal, increased mineralization, or lowered water levels. Ground water impacts will occur in the vicinity of the mines and will have no significant impact on the regional ground water system. Mineralization of surface drainage will increase progressively and peak approaching or even exceeding 2,000 milligrams per liter of dissolved solids in 10 to 12 years before beginning its slow return to baseline conditions. Impacts on base flow will be local and long-term and after the accompanying impact on water quality will be positive.

HYDROLOGIC RECONNAISSANCE OF THE TANANA BASIN, CENTRAL ALASKA
ANDERSON, G. S.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
FOR SALE BY U S GEOLOGICAL SURVEY, WASHINGTON, D C - PRICE $2.00 PER SET. U S GEOLOGICAL SURVEY HYDROLOGIC INVESTIGATIONS ATLAS HA-319, 4 SHEETS, 1970. TEXT, 20 FIG, 4 MAP, 7 TAB, 46 REF.,
Journal Announcement: SWRA0324

THE TANANA BASIN IN INTERIOR ALASKA COVERS APPROXIMATELY 44,500 SQUARE MILES WITH 576 SQUARE MILES OF ITS HEADWATERS IN CANADA. THIS REPORT IS INTENDED TO DEFINE IN BROAD TERMS THE HYDROLOGY OF THE TANANA BASIN. ALTHOUGH BASIC DATA ARE LIMITED, SUFFICIENT INFORMATION IS AVAILABLE TO FORMULATE A FRAMEWORK FOR FURTHER COLLECTION OF BASIC DATA, PRELIMINARY DEVELOPMENT PLANNING, AND IDENTIFICATION OF PROBLEMS. THE TANANA BASIN IS ENTIRELY WITHIN THE DISCONTINUOUS PERMAFROST ZONE OF ALASKA. GROUNDWATER IN THE TANANA BASIN OCCURS UNDER UNCONFINED AND ARTESIAN CONDITIONS. UNCONFINED GROUNDWATER GENERALLY IS FOUND IN UNCONSOLIDATED ALLUVIUM IN THE VALLEYS AND IN FRACTURED BEDROCK BENEATH HIGH SLOPES AND RIDGES. ARTESIAN CONDITIONS GENERALLY OCCUR IN THE LOWER SLOPES WHERE PERMEABLE BEDS ARE CONFINED BY PERMAFROST OR BY IMPERMEABLE SEDIMENTARY BEDS. ALONG THE LOWER HILLSLOPES, FLOWING ARTESIAN WELLS ARE COMMON. THE THERMAL EFFECTS OF WATER EXERT A DOMINANT CONTROL ON THE PERMAFROST REGIMEN. DEEPER LAKES AND RIVERS AND THE CIRCULATION OF GROUNDWATER CAUSE THE DEGRADATION OF PERMAFROST AND LIMIT ITS DISTRIBUTION BOTH VERTICALLY AND AREALLY. THE AVERAGE STREAMFLOW OF THE TANANA RIVER NEAR ITS MOUTH IS ESTIMATED AS 37,000 CFS. APPROXIMATELY 85% OF THIS DISCHARGE ORIGINATES IN THE ALASKA RANGE; APPROXIMATELY 50% OF THE DISCHARGE IS CONTRIBUTED BY 4 TRIBUTARIES FROM THE SOUTH SIDE, THE KANTISHNA, NENANA, NABESNA, AND DELTA RIVERS. (KNAPP-USGS)

Water Availability, Quality, and use in Alaska
Balding, G. O.
Geological Survey, Anchorage, Alaska.
Open-file report 76-513, August 1976. 236 p, 86 fig, 42 tab, 147 ref.,
Journal Announcement: SWRA1008

The Alaska Water Assessment, sponsored by the Water Resources Council, is a specific problem analysis for Alaska of the National Assessment of Water and Related Land Resources. The Alaska region has been divided into six hydrologic subregions and eighteen subareas. For each subarea, estimated mean annual runoff per square mile, suspended-sediment concentrations that can be expected during 'normal' summer runoff, flood magnitudes and frequencies, and ground-water yields are illustrated on maps. Tables show water quality of both ground water and surface water from selected wells and streams. Water use according to the type of use is discussed, and estimates are given for the amounts used. Water-use categories include domestic, irrigation, livestock, seafood processing, oil and gas development, petrochemical processing, pulp mills, hydroelectric, coal processing, steam electric, mineral processing, sand and gravel mining, and fish-hatchery operations. (Woodard-USGS)

HYDROLOGIC RECONNAISSANCE OF STREAMS AND SPRINGS IN EASTERN BROOKS RANGE, ALASKA--JULY 1972
CHILDERS, J. M.; SLOAN, C. E.; MECKEL, J. P.
GEOLOGICAL SURVEY, ANCHORAGE, ALASKA. WATER RESOURCES DIV.
BASIC-DATA REPORT, 1973. 25 P, 20 FIG, 1 TAB, 6 REF.,
Journal Announcement: SWRA0622

ESTIMATES OF BANKFULL DISCHARGE AND MAXIMUM EVIDENT FLOOD PEAK DISCHARGE BY SLOPE-CONVEYANCE METHODS WERE MADE FOR SELECTED STREAMS IN THE EASTERN BROOKS RANGE, ALASKA, BASED ON FIELD OBSERVATIONS. FLOOD DISCHARGES FOR 2-YEAR AND 50-YEAR AVERAGE RECURRENCE INTERVALS WERE ESTIMATED FOR THE SAME SITES USING REGRESSION EQUATIONS THAT RELATE FLOOD DISCHARGE TO BASIN PHYSICAL AND CLIMATIC CHARACTERISTICS. DISCHARGE, TEMPERATURE, AND SPECIFIC CONDUCTANCE OF SELECTED SPRINGS WERE MEASURED DURING THE RECONNAISSANCE AND WATER SAMPLES WERE COLLECTED FOR CHEMICAL ANALYSIS. ALL BUT ONE OF THE SPRINGS DISCHARGED FROM LIMESTONE BEDROCK OR ASSOCIATED COLLUVIAL AND TYPE AND HAS LOW TOTAL DISSOLVED SOLIDS. DISCHARGE, AT TIME OF MEASUREMENT, RANGED FROM ABOUT 4 TO 36 CFS AND TEMPERATURE RANGED FROM ABOUT 3 TO 9C. (WOODARD-USGS)

Bibliography of Reports by Members of the U.S. Geological Survey on the Water Resources of Alaska, 1870 Through 1976
Feulner, A. J.; Reed, K. M.
Geological Survey, Anchorage, AK. Water Resources Div.
Open-file report 77-687, 1977. 112 p.,
Journal Announcement: SWRA1109

This bibliography lists publications prepared by members of the U.S. Geological Survey and published either by the Survey or by the other agencies and organizations between 1870 and the end of December 1976. The titles included are those whose primary topic is hydrology, water resources, or other aspects of water in Alaska. Related subjects, such as geology, included in many of these reports. (Woodard-USGS)

Effects of Placer Mining on Hydrologic Systems in Alaska--Status of Knowledge
Madison, R. J.
Geological Survey, Anchorage, AK. Water Resources Div.
Available from the OFSS, USGS, Box 25425, Denver Fed. Ctr., Denver, CO 80225, paper copy $3.50, microfiche $3.50.

Geological Survey Open-File Report 81-217, 1981. 25 p, 41 Ref.,
Journal Announcement: SWRA1419

The report briefly summarizes the current state of knowledge regarding placer mining in Alaska. A review of literature indicates that nearly all of the significant information on the effects of placer mining on the hydrologic system in Alaska is referenced in available reports. The addition of sediment, as well as other indirect changes this generates, appears to be the primary impact of placer mining on Alaskan streams. Other potential water-quality effects that should be considered are: increases in organic loading in the stream system; increases in minor element content; potential for acid drainage; and impacts on fish and other aquatic biota. Existing information is adequate to define parameters that may be affected by placer mining but inadequate to quantify changes resulting from an individual mining operation or to allow the prediction of the magnitude or duration of the impact. Additional studies that would improve the knowledge of the effects of placer mining include: short-term assessments, using available photographic information and existing hydrologic records, to document historical changes and active placer mining features; short-term studies using emperical sediment-transport formulas to estimate the effects of placer mine activities; and river quality assessments of selected basins affected by placer mining. (USGS)

Hydrologic Reconnaissance near Fourth of July Creek, Seward, Alaska

Nelson, G. L.

Geological Survey, Anchorage, AK. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-223752, Price codes: A02 in paper copy, A01 in microfiche. Geological Sunvey Water-Resources Investigations 81-21, 1981. 10 p, 4 Fig, 2 Tab, 2 Ref.,
Journal Announcement: SWRA1421

The 1.3-square-mile alluvial fan of Fourth of July Creek, Seward, Alaska, is being developed as an industrial area and port. Fourth of July Creek is a glacier-fed stream that occupies a braided channel near the middle of the fan. The presence of glacial flow during the summer and low discharge during the winter make streamflow a poor source of water for municipal and industrial use. Water infiltrates the fan from streams and precipitation and recharges an unconfined alluvial aquifer. Average recharge is 40-50 cubic feet per second, and ground water flows toward the coast where it discharges in springs and a 0.3-mile gaining reach of the creek. Properties and concentrations of all measured chemical constituents of water samples from two wells were less than the maximum amounts recommended for drinking water. Both the aquifer and the overlying unsaturated materials are coarse grained. The coarse-grained materials are poor filters and make the aquifer susceptible to pollution by contaminants disposed of or spilled on the alluvial fan. Avalanches may block the creek and cause flooding by directing streamflow into new or abandoned channels. (USGS)

Results of Exploratory Drilling at Point Mackenzie, Alaska, 1981

Patrick, L.

Geological Survey, Anchorage, AK. Water Resources Div.

Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $1.25, Microfiche $3.25. Geological Survey Open-File Report 81-1072, 1981. 8 p, 2 Fig, 3 Tab, 1 Ref.,

Journal Announcement: SWRA1509

The Matanuska-Susitna Borough anticipates industrial development near Point MacKenzie, Alaska. Because little hydrologic information is available for the area, the Borough contracted for the drilling of two test wells. It was found that: Both wells penetrated unconsolidated stratified clay, silt, sand, and gravel; each well penetrated a shallow unconfined and deeper confined aquifers; the water levels in the wells rise and fall with the tide; the chemical analyses indicate that the water quality meets the Alaska Drinking Water Standards, except for slightly high levels of manganese and pH; and the potential for saltwater intrusion should be evaluated as part of future studies. (USGS)

Data from a Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska

Scully, D. R.; Krumhardt, A. P.; Kernodle, D. R.

Geological Survey, Anchorage, AK. Water Resources Div.

Geological Survey Open-File Report 80-1206, 1980. 54 p, 1 Fig, 1 Tab.,

Journal Announcement: SWRA1412

Data are tabulated from a hydrologic study of the Beluga, Peters Creek, and Healy coal areas in Alaska from July 1975 to June 1979. These include streamflow and water-quality data for all three areas, groundwater data for the Beluga and Healy coal areas, and information from springs in the Beluga coal area. Results of analyses of samples of the benthic invertebrate community in the Beluga area are also included. (USGS)

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska

Scully, D. R.; Krumhardt, A. P.; Kernodle, D. R.

Geological Survey, Anchorage, AK. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168402, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-56, 1981. 71 p, 37 Fig, 17 Tab, 31 Ref.,

Journal Announcement: SWRA1510

The Beluga, Peters Creek, and Healy coal areas in Alaska were studied during 1975-1978, with major emphasis on surface-water hydrology and water quality. In the Beluga coal area, mean annual discharge is estimated to range from 2.2 to 3.4 cubic feet per second per square mile of drainage area. The 7-day low flow with a 10-year recurrence interval is estimated to be 0.3 to 0.6 cubic feet per second per square mile. The surface waters are calcium bicarbonate type; have low concentrations of nutrients; and, at times, may contain dissolved iron and manganese in concentrations in excess of U.S. Environmental Protection Agency recommended limits. The pooled diversity index of the benthic invertebrate community ranges from 2.93 to 4.06. No ground-water wells have been drilled in the potential mining areas. Water quality of streams in the Peters Creek coal area is similar to that of the streams in the Beluga coal area. No attempt is made to define streamflow characteristics in the Peters Creek coal area due to poor correlations with nearby gaging stations. In the Healy coal area, streamflow characteristics are dissimilar between the two major basins studied. Lignite Creek is estimated to have less yield than Healy Creek. Studied tributaries of Healy and Lignite Creeks contain waters with a dissolved solids range of 111 to 636 milligrams per liter and have calcium and bicarbonate or magnesium and bicarbonate as principal ions. Iron and manganese concentrations are high at some times of the year. The concentrations of sodium and chloride increases significantly in the lower reaches of Lignite Creek. (USGS)

Index of Streamflow and Water-Quality Records to September 30, 1978, Southeast Alaska
Still, P. J.
Geological Survey, Anchorage, AK. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-698, 1980. 26 p, 1 Fig, 1 Tab.,
Journal Announcement: SWRA1405

This report, which is one of a series of reports for Alaska, lists stations in southeast Alaska at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of southeast Alaska and a table listing the types of data collected and periods of record. (USGS)

Index of Streamflow and Water-Quality Records to September 30, 1978, Northwest Alaska
Still, P. J.
Geological Survey, Anchorage, AK. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.75 in paper copy, $3.50 in

microfiche. Geological Survey Open-File Report 80-533, 1980. 19 p, 1 Fig, 1 Tab.,

Journal Announcement: SWRA1405

This report, which is one of a series of reports for Alaska, lists stations in northwest Alaska at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of northwest Alaska and a table listing the types of data collected and periods of record. (USGS)

Index of Streamflow and Water-Quality Records to September 30, 1978, Southwest Alaska

Still, P. J.

Geological Survey, Anchorage, AK. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-551, 1980. 13 p, 1 Fig, 1 Tab.,

Journal Announcement: SWRA1405

This report, which is one of a series of reports for Alaska, lists stations in southwest Alaska, at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of southwest Alaska, and a table listing the types of data collected and periods of record. (USGS)

Index of Streamflow and Water-Quality Records to September 30, 1978, Yukon Basin, Alaska

Still, P. J.

Geological Survey, Anchorage, AK. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $5.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-552, 1980. 41 p, 1 Fig, 1 Tab.,

Journal Announcement: SWRA1405

This report, which is one of a series of reports for Alaska, lists stations in Yukon Basin, Alaska, at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of Yukon Basin, Alaska, and a table listing the types of data collected and periods of record. (USGS)

Index of Streamflow and Water-Quality Records to September 30, 1978, south-Central Alaska

Still, P. J.

Geological Survey, Anchorage, AK. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-600, 1980. 54 p, 1 Fig, 1 Tab.,

Journal Announcement: SWRA1405

This report, which is one of a series of reports for

Alaska, lists stations in south-central Alaska at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of south-central Alaska and a table listing the types of data collected and periods of record. (USGS)

Index of Streamflow and Water-Quality Records to September 30, 1978, Arctic Slope Alaska
Still, P. J.
Geological Survey, Anchorage, AK. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-554, 1980. 18 p, 1 Fig, 1 Tab.,
Journal Announcement: SWRA1405
This report, which is one of a series of reports for Alaska, lists stations in Arctic Slope, Alaska, at which streamflow and water quality data have been collected by the U.S. Geological Survey. Included are a hydrologic subregion map of Arctic Slope, Alaska, and a table listing the types of data collected and periods of record. (USGS)

Index of Surface Water Quality Records to September 30, 1973, Northwest and Arctic Slope, Alaska
Still, P. J.
Geological Survey, Anchorage, Alaska. Water Resources Div.
Open-file report (basic data), 1976. 9 p, 1 fig, 2 tab.,
Journal Announcement: SWRA1013
This report includes a map showing the locations of all surface water quality sites in Northwest and Arctic Slope, Alaska, a table listing the types of data collected, and the periods of record to September 30, 1973. (Woodard-USGS)

Index of Surface Water Quality Records to September 30, 1973, Southwest Alaska
Still, P. J.
Geological Survey, Anchorage, Alaska. Water Resources Div.
Open-file report (basic data), 1976. 12 p, 1 fig, 1 tab.,
Journal Announcement: SWRA1013
This report includes a map showing the locations of all surface water quality sites in southwest Alaska, a table listing the types of data collected, and the periods of record to September 30, 1973. (Woodard-USGS)

A REVIEW OF WATER RESOURCES OF THE UMIAT AREA, NORTHERN ALASKA
WILLIAMS, JOHN R.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
GEOLOGICAL SURVEY CIRCULAR 636, 1970. 8 P, 2 FIG, 2 TAB, 11 REF.,
Journal Announcement: SWRA0409
IN THE UMIAT AREA OF NORTHERN ALASKA, SURFACE-WATER

SUPPLIED FROM THE COLVILLE RIVER, SMALL TRIBUTARY CREEKS, AND LAKES ARE ABUNDANT IN SUMMER BUT LIMITED IN WINTER BY LOW OR ZERO FLOW IN STREAMS AND THICK ICE COVER ON LAKES. FRESH GROUNDWATER OCCURS IN UNFROZEN ZONES IN ALLUVIUM AND IN THE UPPER PART OF BEDROCK BENEATH THE COLVILLE RIVER AND BENEATH LAKES THAT DO NOT FREEZE TO THE BOTTOM IN WINTER. BRACKISH OR SALINE GROUNDWATER OCCURS IN BEDROCK BENEATH AS MUCH AS 1,055 FEET OF PERMAFROST IN THE ARCTIC FOOTHILLS AND BENEATH 750 TO 800 FEET OF PERMFROST BENEATH LOW TERRACES OF THE COLVILLE RIVER VALLEY. THE FOOTHILL AREA IS UNFAVORABLE FOR DEVELOPING SUPPLIES OF POTABLE GROUNDWATER BECAUSE OF THE GREAT DEPTH TO WATER, PREDOMINANCE OF BRACKISH OR SALINE WATER, AND LOW POTENTIAL YIELD OF THE BEDROCK. IN THE COLVILLE RIVER VALLEY, SHALLOW UNFROZEN ALLUVIUM BENEATH THE RIVER AND DEEP LAKES WILL YIELD ABUNDANT YEAR-ROUND SUPPLIES OF GROUNDWATER, BUT THE BEDROCK BELOW PERMAFROST YIELDS LESS THAN 10 GALLONS PER MINUTE OF SALINE OR BRACKISH WATER. (WOODARD-USGS)

GROUNDWATER IN THE PERMAFROST REGIONS OF ALASKA
WILLIAMS, JOHN R.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, US GOVERNMENT PRINTING OFFICE, WASHINGTON, DC, 20402 - PRICE $1.00. GEOLOGICAL SURVEY PROFESSIONAL PAPER 696, 1970. 83 P, 25 FIG, 4 TAB, 270 REF.,
Journal Announcement: SWRA0401

ALTHOUGH GROUNDWATER IN PERMAFROST REGIONS IN ALASKA OCCURS ACCORDING TO THE SAME GEOLOGIC AND HYDROLOGIC PRINCIPLES PREVAILING IN TEMPERATE REGIONS, SUBFREEZING TEMPERATURES RESULT IN PROFOUND MODIFICATION OF GROUNDWATER FLOW SYSTEMS. FROZEN GROUND IS AN IMPERMEABLE LAYER WHICH: (1) RESTRICTS RECHARGE, DISCHARGE, AND MOVEMENT OF GROUNDWATER, (2) ACTS AS A CONFINING LAYER, AND (3) LIMITS THE VOLUME OF UNCONSOLIDATED DEPOSITS AND BEDROCK IN WHICH LIQUID WATER MAY BE STORED. FROZEN GROUND IN MANY AREAS ELIMINATES SHALLOW AQUIFERS AND REQUIRES THAT WELLS BE DRILLED DEEPER THAN IN SIMILAR GEOLOGIC ENVIRONMENTS HAVING NO PERMAFROST. LOCAL VARIATIONS IN THE THICKNESS, AREAL EXTENT, AND TEMPERATURE OF PERMAFROST DEPEND ON VARIABLE THERMAL PROPERTIES OF EARTH MATERIALS AND ON LOCAL DIFFERENCES IN THE RATE OF HEAT FLOW FROM WITHIN THE EARTH, CLIMATE, TOPOGRAPHY, VEGETATION, GEOLOGY, AND HYDROLOGY. GROUNDWATER OCCURS ABOVE, BELOW, AND LOCALLY WITHIN, PERMAFROST. IN THE CONTINUOUS-PERMAFROST ZONE, THE MOST ECONOMICALLY DEVELOPED SOURCES OF WATER ARE IN UNFROZEN ALLUVIUM BENEATH LARGE LAKES AND RIVERS. IN THE DISCONTINUOUS-PERMAFROST ZONE, GROUNDWATER IS PRODUCED LOCALLY FROM SHALLOW AQUIFERS ABOVE PERMAFROST OF OFFSHORE BARS AND SPITS BECAUSE WATER WITHIN OR BELOW THE FROZEN BEACH DEPOSITS IS SALINE. (KNAPP-USGS)

Summary Appraisals of the Nation's Ground-Water

Resources--Alaska
Zenone, C.; Anderson, G. S.
Geological Survey, Anchorage, AL. Water Resources Div.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $1.60. Geological Survey Professional Paper 813-P, 1978. 28 p, 13 fig, 4 tab, 77 ref.,
Journal Announcement: SWRA1211

Ground water is a large but virtually unexplored and undeveloped resource in Alaska. Perennially frozen ground (permafrost) influences the occurrence, movement and availability of ground water except in the southern and southeastern coastal areas of the State. The most extensive aquifers occur in alluvium of major river valleys such as the Yukon, Tanana, Kuskokwim and Susitna. Large amounts of ground water are also stored in glacial outwash aquifers in coastal basin and valley deposits at Anchorage, Kenai and Juneau. Individual wells yielding more than 1,000 gallons per minute have been developed in the Tanana River Valley, Cook Inlet lowland, and the coastal valleys at Seward and Juneau. Comparable yields should be possible in other areas that have similar geohydrologic environments. Both recharge and discharge of the large alluvial aquifers are concentrated along stream channels. It is estimated that 25 percent of the total volume of streamflow in Alaska (exclusive of coastal areas) is contributed by ground-water discharge. (Woodard-USGS)

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Water-Resources Reconnaissance of the Ouachita Mountains, Arkansas

Albin, Donald R.

U.S. Geological Survey Water-Supply Paper 1809-J

Water for domestic and nonirrigation farm use can be obtained from wells nearly everywhere in the Ouachita Mountains, and ground-water supplies as large as 50,000 gpd (gallons per day) often can be developed. In general, the best procedure for developing ground-water supplies in the mountains is to drill wells on the flanks of anticlines (in synclinal valleys) and off the noses of plunging anticlines. Ground water for industrial or municipal use in the area may require treatment for removal of iron and calcium magnesium hardness.

Streams are the best potential sources of water for municipal growth and economic development in the Ouachita Mountains. Although most streams in the mountains occasionally have very little or no flow, with adequate storage facilities they generally are the best sources of supply when water demands approach 50,000 gpd. The streams contain water of excellent quality that chemically is suitable for nearly all uses.

Geology and Ground-water Resources of Bradley, Calhoun, and Ouachita Counties, Arkansas

Albin, Donald R.

U.S. Geological Survey Water-Supply Paper 1779-G

Bradley, Calhoun, and Ouachita Counties comprise an area of approximately 2,000 square miles in south-central Arkansas. The area is in the Coastal Plain physiographic province, and is characterized by heavily timbered flatlands and low hills.

The geologic units at the surface in the counties are of Eocene, Pleistocene, and Recent age. Water for domestic and small-farm use can be obtained in and at short distances downdip from the outcrop areas of each of the formations. However, only the Sparta Sand, the Cockfield Formation, the terrace deposits, and the alluvium are major fresh-water aquifers.

The total ground-water use in the counties is approximately 6.1 mgd (million gallons per day). Of this total, about 5.0 mgd is withdrawn from the Sparta Sand, about 0.1 mgd is withdrawn from the Cockfield Formation, and about 1.0 mgd is withdrawn from the terrace deposits and alluvium. Most of the pumpage is concentrated in the vicinity of the major towns and cities. Each of the aquifers is capable of yielding larger quantities of water than presently are being withdrawn from them. However, in a small area near Camden the total pumpage from the Sparta Sand is almost the maximum sustained yield.

The ground water in Bradley, Calhoun, and Ouachita Counties primarily is of the sodium bicarbonate type. Water from the Sparta Sand and the Cockfield Formation is suitable for most municipal, industrial, agricultural, and domestic uses.

Well records, depth-to-water measurements and logs of selected

wells and test holes, and chemical analyses of ground water in Bradley, Clahoun, and Ouachita Counties, Arkansas
Albin, D. R., 1963
U.S. Geological Survey Open-File Report

Forest Species as Indicators of Flooding in the Lower White River Valley, Arkansas
Bedinger, M. S., 1971
U.S. Geological Survey Professional Paper 750-C, p. C248-C253

The dominant environmental factor of forest habitats within the lower valley of the White River, Ark., is flooding. The flood plain consists of a series of terraces. Distribution of forest species on the terrace levels is related to flooding. The relationship is sufficiently distinct to permit determination of flood characteristics at a given site by evaluation of forest-species composition. The vegetation of the lower White River valley can be divided into four groups. Each group occurs on sites having distinctly different flooding characteristics. On sites flooded 29-40 percent of the time, the dominant species are water hickory and overcup oak. On sites flooded 10-21 percent of the time, a more varied flora exists-including nuttall oak, willow oak, sweetgum, southern hackberry, and American elm. The third group of sites is subject to flooding at intervals of from 2 to 8 years. This group is marked by presence of southern red oak, shagbark oak, and black gum. The presence of blackjack oak marks the fourth group (not flooded in historic times).

Ground-Water Potential of the Alluvium of the Arkansas River between Little Rock and Fort Smith, Arkansas
Bedinger, M. S., Emmett, L. F., and Jeffery, H. G., 1963
U.S. Geological Survey Water-Supply Paper 1669-L.

Alluvium along 200 miles of the Arkansas River from Fort Smith, Ark., on the western border of the State, to Little Rock in the approximate geographic center of the State, is potentially the most important aquifer in the Interior Highlands of Arkansas. The flood plain of the river generally is 1 to 3 miles wide, but in places its width is 5 miles. The flood plain is underlain by alluvial sand, gravel, silt, and clay which ranges in thickness from about 40 feet near Fort Smith to about 80 feet near Little Rock. Wells tapping the alluvium yield between 300 and 700 gpm (gallons per minute). Wells tapping the sandstone and shale of Mississippian and Pennsylvanian age, which border the alluvium, generally yield less than 50 gpm.

Generally, ground water in the alluvium is under water-table conditions. Movement of ground water is from the valley wall to the river, and the river acts as a drain throughout most of the year.

The alluvium is recharged primarily by infiltration of rainfall. On the average, the aquifer is recharged at the rate of 10 inches per year of approximately 130 mgd (million gallons per day). Pumpage from the alluvium is about 3.2 mgd. The amount of recharge to the aquifer can be increased many times over the natural recharge rate by constructing wells that will induce recharge from the river.

Median values of the principal constituents in water from the alluvium indicate that it is a calcium magnesium bicarbonate water. Local high concentrations of sulfate, chloride, or nitrate are probably the result of water moving from other formations into the alluvium. High concentrations of chloride in the water however, can be the result of influent seepage of river water.

The quality of water' in the alluvium generally is suitable for domestic and irrigation purposes. The hardness and high content of iron and nitrate, however, makes the water undesirable for some industrial uses.

Alluvial Aquifer of the Cache and St. Francis River Basins, Northeastern Arkansas

Broom, M. E.; Lyford, F. P.

Geological Survey, Little Rock, AR. Water Resources Div.

Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Paper copy $22.75, Microfiche $10.00. Geological Survey Open-File Report 81-476, 1981. 48 p, 4 Fig, 13 Plates, 5 Tab, 23 Ref.,

Journal Announcement: SWRA1423

The alluvial aquifer underlies about 9,000 square miles of the study area. Well yields from the aquifer commonly are from 1,000 to 2,000 gallons per minute. Flow toward the main area of pumping stress is eastward from the Cache River and westward from the St. Francis River. The Memphis aquifer acts as a conduit through Crowleys Ridge for induced flow from the alluvial aquifer since the early 1900's has been mostly for rice irrigation. Total pumpage for rice in 1978 was about 1,650,000 acre-feet, of which about 88 percent was pumped from the aquifer west of Crowleys Ridge. Water levels in wells west of the ridge in parts of Poinsett, Cross, and Craighead Counties in 1978 were 75 feet below land surface and declining about 2 feet per year. Digital-model analysis indicated that at the end of 1978 water was being removed from aquifer storage at the rate of 540,000 acre-feet per year, and streamflow, mostly from the Cache River and Bayou DeView, was being captured at the rate of 430,000 acre-feet per year. Projecting the 1978 pumping rate of 1,460,000 acre-feet per year, the pumping rate would have to be reduced by about 110,000 acre-feet per year by 1990 to sustain sufficient aquifer saturation for water needs through the year 2000 in all parts of Poinsett, Craighead, and Cross Counties west of Crowleys Ridge. (USGS)

Hydrology of the Bayou Bartholomew Alluvial Aquifer-Stream System, Arkansas

Broom, M. E., and Reed, J. E., 1973

U.S. Geological Survey Open-File Report 73-34

The study area comprises about 3,200 square miles of the Mississippi Alluvial Plain in southeast Arkansas. About 90 percent of the area drains south to the Ouachita River in Louisiana.

The alluvial aquifer and the streams are hydraulically connected and are studied as an aquifer-stream system. Bayou Bartholomew is a principal stream of the system.

The aquifer is underlain by confining strata of the Jackson Group and Cockfield Formation.

The mean annual surface-water yield of the area that drains to the Ouachita River basin is nearly 2 million acre-feet. Flood-control projects have significantly reduced flooding in the area. Basin boundaries and low-flow characteristics of streams have been altered as a result of the flood-control projects and streamflow diversion for irrigation.

The direction of ground-water flow generally is southward. Bayou Bartholomew functions mostly as a drain for ground-water flow from the west and as a recharge source to the aquifer east of the bayou. As a result of navigation pools, the Arkansas River is mostly a steady-recharge source to the aquifer.

Pumpage from the aquifer and streams increased from about 20,000 acre-feet in 1941 to 237,000 acre-feet in 1970.

Estimates of flow, derived from analog analysis but lacking field verification, indicate that recharge to the aquifer in 1970 was about 161,000 acre-feet. About 70 percent of the recharge was by capture from streams as a result of ground-water pumpage. Discharge from the aquifer was about 233,000 acre-feet. About 80 percent of the discharge was through wells.

Stream diversion in 1970 from capture and open channel, excluding capture from the Arkansas and Mississippi Rivers, was about 110,000 acre-feet. Return flow to streams from rice irrigation and fishponds was about 60,000 acre-feet.

The chemical quality of streamflows is excellent for irrigation. Water from the aquifer generally ranges from permissible to excellent for irrigation. The use of water from the aquifer in the flood-plain area, exclusive of irrigation, is severely limited unless it is treated to remove the iron and reduce the hardness.

Waste-load allocation studies of Arkansas streams, Arkansas River basin, Petit Jean and Poteau Rivers, Segment 3F
Bryant, C. T., 1974
U.S. Geological Survey Open-File Report

Waste-load allocation studies for Arkansas streams, Ouachita River basin, Segment 2F
Bryant, C. T., 1975
U.S. Geological Survey Open-File Report

Waste-load allocation studies for Arkansas streams, St. Francis River basin, L'Anguille River, Segment 5B
Bryant, C. T., Jennings, M. E., and Reed, J. E., 1974
U.S. Geological Survey Open-File Report

Waste-load allocation studies for Arkansas streams, St. Francis River basin, St. Francis River, Segment 5C
Bryant, C. T., Jennings, M. E., and Bauer, D. P., 1974
U.S. Geological Survey Open-File Report

Water-Quality Assessment of the L'Anguille River Basin, Arkansas
Bryant, C. T.; Morris, E. E.; Terry, J. E.
Geological Survey, Little Rock, AR. Water Resources Div.
Available from: OFSS BX 25425, Fed. Ctr. Denver, CO paper copy $21.75 microfiche $3.50. Geological Survey open-file report 79-1482, 1979. 20 p, 22 Fig, 23 Tab, 45 Ref.,
Journal Announcement: SWRA1311

For several years, dissolved oxygen in the L'Anguille River has been reduced to concentrations of less than 5.0 milligrams per liter during the summer and fall. In addition, concentrations of pesticides have been reported consistently at one long-term station on the river, and trace metals have been reported at two long-term monitoring sites. The U.S. Geological Survey conducted an intensive study of the L'Anguille River basin during the summer and fall of 1978 in cooperation with the Arkansas Department of Pollution Control and Ecology. An assessment of the general water quality was made; the causes of stream dissolved-oxygen reductions were determined; and the occurrence of pesticides and trace metals in the basin was documented. A steady-state, segmented, dissolved-oxygen model was calibrated and used to project simulated dissolved-oxygen profiles. (Kosco-USGS)

Drainage areas of streams in Arkansas, St. Francis River basin
Christensen, R. C., Gilstrap, R. C., and Sullavan, J. N., 1967
U.S. Geological Survey Open-File Report

Well records, depth-to-water measurements and logs of selected wells and test holes, and chemical analyses of groundwater in the Arkansas Valley region, Arkansas
Cordova, R. M., 1962
U.S. Geological Survey Open-File Report

Reconnaissance of the Ground-water resources of the Arkansas Valley region, Arkansas
Cordova, R. M., 1963
U.S. Geological Survey Water-Supply paper 1669-BB, 33 p.

Report of the annual yield of the Arkansas River Basin Compact, Arkansas-Oklahoma, 1978 water year
Ducret, G. L., Jr., 1979
U.S. Geological Survey Open-File Report 79-422

Ground-water levels in Arkansas, Spring 1983
Edds, Joe

U.S. Geological Survey Open-File Report 83-268

The report contains about 650 ground-water level measurements made in observation wells in Arkansas in the spring of 1983. In addition, the report contains well hydrographs relating to the alluvial aquifer and the Sparta Sand, the most important aquifers with respect to ground-water availability and use in Arkansas.

Ground-water levels in Arkansas, Spring 1982
Edds, Joe
U.S. Geological Survey Open-File Report 82-852

The report contains about 640 ground-water level measurements made in observation wells in Arkansas in the spring of 1982. In addition, the report contains potentiometric-surface maps and well hydrographs relating to the alluvial aquifer and the Sparta Sand, the most important aquifers with respect to ground-water availability and use in Arkansas.

Floodflow characteristics of Archey Creek along U.S. Highway 65, at Clinton, Arkansas
Gilstrap, R. C., 1975
U.S. Geological Survey Open-File Report 75-603

Floodflow characteristics of Illinois River tributary near Siloam Springs, Arkansas
Gilstrap, R. C., 1976
U.S. Geological Survey Open-File Report 76-337

Water-resources investigations in Arkansas, Fiscal Year 1981
Gurley, M. O., 1981
U.S. Geological Survey Open-File Report 81-1003, 44 p.

WATER RESOURCES OF GRANT AND HOT SPRING COUNTIES, ARKANSAS
HALBERG, H. N.; BRYANT, C. T.; HINES, M. S.
GEOLOGICAL SURVEY, WASHINGTON, D. C.
U. S. GEOL SURV WATER-SUPPLY PAP 1857, 64 P, 1968. 12 FIG, 6 PLATE, 12 TAB, 82 REF.,
Journal Announcement: SWRAU207

THE AVAILABILITY AND QUALITY OF GROUNDWATER AND THE LITHOLOGY OF THE PRINCIPAL AQUIFERS ARE DESCRIBED, AND INFORMATION IS GIVEN ON SURFACE WATER AVAILABILITY, INCLUDING MAGNITUDE AND FREQUENCY OF FLOODS AND LOW FLOWS, DURATION OF DAILY FLOWS, AND STORAGE REQUIREMENTS FOR DEPENDABLE YIELDS OF STREAMS. QUALITY OF WATER IN OUACHITA AND SALINE RIVERS AND MANY TRIBUTARY STREAMS IS DESCRIBED, AND EXISTING OR POTENTIAL RIVER AND GROUNDWATER POLLUTION IS CITED. THE OUACHITA, SALINE, AND CADDO RIVERS YIELD LARGE QUANTITIES OF SOFT, GOOD-QUALITY WATER. SMALL STREAMS IN SOUTHEASTERN HOT SPRING COUNTY AND IN THE OUACHITA MOUNTAINS HAVE RELATIVELY HIGH BASE FLOW; IN GRANT COUNTY SMALL STREAMS YIELD LITTLE WATER DURING DRY PERIODS. AT TIMES, SEWAGE AND MINE DRAINAGE POLLUTE A PART

OF OUACHITA RIVER IN THE LAKE CATHERINE AREA. AT LOW FLOW, HURRICANE CREEK WATER IS UNFIT FOR MOST USES. WELLS IN THE SPARTA SAND, THE PRINCIPAL AQUIFER, YIELD AS MUCH AS 850 GPM OF SOFT WATER IN GRANT COUNTY. THE CARRIZO SAND AND CANE RIVER FORMATION ARE POTENTIALLY IMPORTANT AQUIFERS IN GRANT COUNTY AND SOUTHEASTERN HOT SPRING COUNTY. WELLS IN THE WILCOX GROUP YIELD AS MUCH AS 300 GPM OF FRESH WATER IN SOUTHEASTERN HOT SPRING COUNTY AND SOUTHWESTERN GRANT COUNTY; IN THE REST OF GRANT COUNTY ITS WATER IS BRACKISH. ALLUVIUM ALONG THE PRINCIPAL STREAMS AND IN CONSOLIDATED ROCKS OF THE OUACHITA MOUNTAINS YIELD SMALL QUANTITIES OF WATER VARIABLE IN QUALITY FROM PLACE TO PLACE. SOME OF THE ALLUVIAL WATER HAS HIGH NITRATE CONTENT AND MAY BE A HEALTH HAZARD. (LANG-USGS)

Coal Resources of Arkansas, 1954
Haley, B. R., 1960
U.S. Geological Survey Bulletin 1072-P, p. 796-831

Ground Water in the Springfield-Salem Plateaus of Southern Missouri and Northern Arkansas. (Duplicated see Missouri).
Harvey, E. J.
Geological Survey, Rolla, MO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-205635, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-101, December, 1980. 66 p, 25 Fig, 6 Tab, 38 Ref.,
Journal Announcement: SWRA1420

WATER RESOURCES OF CLAY, GREENE, CRAIGHEAD, AND POINSETT COUNTIES, ARKANSAS
HINES, M. S.; PLEBUCH, R. O.; LAMONDS, A. G.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
AVAILABLE FROM USGS, WASHINGTON, DC 20242 PRICE $1.50 PER SET. GEOLOGICAL SURVEY HYDROLOGIC INVESTIGATIONS ATLAS HA-377, 1972. 2 SHEETS, 8 FIG, 11 MAP, 7 TAB, 27 REF.,
Journal Announcement: SWRA0516
FOURTEEN ILLUSTRATIONS AND TABLES IN THIS 2-SHEET HYDROLOGIC ATLAS DESCRIBE THE WATER RESOURCES OF CLAY, GREENE, CRAIGHEAD, AND POINSETT COUNTIES, ARKANSAS. THE OCCURRENCE, QUANTITY, AVAILABILITY, AND QUALITY OF GROUND AND SURFACE WATER AND THE VARIABILITY IN THESE SUPPLIES ARE DETERMINED. IN ADDITION, WATER PROBLEMS PECULIAR TO THE AREA ARE DEFINED AND CORRECTIVE MEASURES SUGGESTED. AVERAGE ANNUAL STREAMFLOW RANGES FROM 1.2 CFS PER SQ MI IN THE WESTERN PART OF THE FOUR COUNTIES TO 1.4 CFS PER SQ MI IN THE EASTERN PART. AVERAGE ANNUAL PRECIPITATION IS ABOUT 48 INCHES. USE OF WATER FOR AGRICULTURE GREATLY EXCEEDS ALL OTHER USES COMBINED. IN 1965, 111.4 MGD WAS USED FOR RICE IRRIGATION, AND 71.5 MGD WAS USED FOR IRRIGATION OF OTHER CROPS. AN ADDITIONAL 16.9 MGD

WAS USED BY INDUSTRY, MUNICIPALITIES, AND OTHERS. OF THESE AMOUNTS, 180.1 MGD WAS GROUNDWATER AND 19.7 MGD WAS SURFACE WATER, OR A TOTAL OF 199.8 MGD. (WOODARD-USGS)

GEOHYDROLOGY OF THE COASTAL PLAIN AQUIFERS OF ARKANSAS
HOSMAN, R. L.
GEOLOGICAL SURVEY, WASHINGTON, D. C.
GEOL SURV HYDROL INVEST ATLAS HA-309, 1 SHEET, 1969. 3 MAP, 3 TAB, TEXT.,
Journal Announcement: SWRA0211

DATA ON WATER QUALITY, WATER WELLS, AND CHARACTER AND EXTENT OF THE GULF COASTAL PLAIN SYSTEM OF AQUIFERS IN ARKANSAS ARE SUMMARIZED IN A 1-SHEET HYDROLOGICAL ATLAS CONSISTING OF BLOCK DIAGRAMS SHOWING STRATIGRAPHY AND EXTENT OF AQUIFERS, WATER CHEMICAL QUALITY DIAGRAMS, AND TABLES. THE HYDROLOGICAL CHARACTERISTICS OF THE PRINCIPAL AQUIFERS ARE DESCRIBED AND A SUMMARY OF PUMPING TEST RESULTS IS GIVEN. THE ALTITUDE OF THE BASE OF FRESH WATER IS SHOWN BY A MAP. (KNAPP-USGS)

Water-Quality Modeling for Waste Load Allocation Studies in Arkansas--Stream Dissolved Oxygen and Conservative Minerals
Jennings, Marshall E., and Bryant, Charles T.
U.S. Geological Survey Open-File Report

Waste load allocation studies in Arkansas form a central part of the development and implementation of basin water-quality management plans required of Arkansas Department of Pollution Control and Ecology by the Environmental Protection Agency (EPA). This report describes the methodology to be used in Arkansas, waste load allocation studies. Steady-state segmented dissolved-oxygen (DO) analysis of river-basin segments is the recommended basis for waste load allocation studies. A dilution model, based on the mass-balance principle, is used for analysis of stream conservative mineral loads. Data collection and laboratory procedures to support such a modeling effort are discussed.

Discharge Data at Water-Quality Monitoring Stations in Arkansas, published annually since 1975.
Knott, R. K.
Geological Survey, Little Rock, AR. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225,

Discharge data were computed for a network of water-quality monitoring stations operated by the Arkansas Department of Pollution Control and Ecology. Some of the sites are located at U.S. Geological Survey of U.S. Army Corps of Engineers daily-discharge stations, but most sites are at points where discharges are not regularly measured. (USGS)

Time of Travel of Selected Arkansas Streams
Lamb, T. E., 1983
U.S. Geological Survey Open-File Report 82-4048
Traveltime of water-soluble materials in streams is important for stream modeling, pollution studies, and estimating arrival time of contaminants to points downstream from spills. Between 1971 and 1981, time-of-travel and dispersion measurements were made in 15 streams in Arkansas. Most of the streams studied were at or near base flow. Graphs are presented for predicting traveltime of solutes in segments of the streams studies. The relationship of time of passage and peak unit concentration to traveltime is presented for two of the streams. Examples of use and application of the data are given.

Water-Quality Investigation of the Vache Grasse Creek Watershed, Sebastian County, Arkansas
Lamb, T. E., 1978
U.S. Geological Survey Open-File Report 78-903
The results of a 1-year study in the upper Vache Grasse Creek watershed are presented to document surface-water quality conditions before implementation of Soil Conservation Service programs. Analysis of samples collected at four sites showed that during periods of warm weather several of the parameters sampled produced unusually high or low values that indicated possible water-quality problems. Low dissolved-oxygen concentration, high nitrogen and organic carbon concentrations, and high coliform bacteria counts were found at sampling sites upstream from the Greenwood water-supply lake. Sampling in and downstream from the lake indicated that the quality of the water passing through the lake was improved significantly. However, sampling in the lake indicated that there is a large layer of water with low oxygen concentration and a buildup of phosphorus, iron, manganese, and some other metals in the bottom ooze.

Water-Quality Investigation of the Tyronza River Watershed, Arkansas
Lamb, T. E.
Geological Survey, Little Rock, AR. Water Resources Div.
Geological Survey open-file report 78-175, 1978. 32 p, 4 fig, 8 tab, 9 ref.,
Journal Announcement: SWRA1115
The results of a 1-year study of surface-water quality in the Tyronza River Watershed, Arkansas, are presented to document conditions before implementation of Soil Conservation Service Programs. The report includes a general description of the watershed's topography, geology, and aquifers, and the results of monthly measurements of discharge at five sites, and several physical and chemical parameters, plus quarterly analyses for several ions and semiannual analyses of bottom material for various pesticides. The results indicate that the quality of the water in the streams and ditches samples is normal for an intensely farmed area such as this

watershed. (Woodard-USGS)

Water-Quality Investigation of the Caney Creek Watershed, Northeast Arkansas

Lamb, T. E.; Newsom, G.

Geological Survey, Little Rock, AR. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 79-1064, 1979. 16 p, 1 Fig, 3 Tab, 11 Ref.,

Journal Announcement: SWRA1407

The results of a 1-year study, in 1977-78, of surface-water quality in the Caney Creek watershed, northeast Arkansas, are presented to document conditions before implementation of Soil Conservation Service programs. The report includes a general description of the watershed's topography, geology, and aquifers, and the results of several measurements at two sites of discharge, and a number of physical and chemical parameters. (USGS)

WATER RESOURCES OF HEMPSTEAD, LAFAYETTE, LITTLE RIVER, MILLER, AND NEVADA COUNTIES, ARKANSAS

LUDWIG, A. H.

GEOLOGICAL SURVEY, WASHINGTON, D.C. WATER-SUPPLY PAPER 1998, 1972. 41 P, 9 FIG, 5 PLATE, 10 TAB, 23 REF.,

Journal Announcement: SWRA0618

THE FIVE-COUNTY AREA IN SOUTHWEST ARKANSAS THAT CONSISTS OF HEMPSTEAD, LAFAYETTE, LITTLE RIVER, MILLER, AND NEVADA COUNTIES POSSESSES ABUNDANT WATER RESOURCES. NEARLY ALL WATER SUPPLIES ARE OBTAINED FROM GROUNDWATER. SURFACE WATER IS USED PRIMARILY FOR MUNICIPAL SUPPLY AT TEXARKANA AND FOR INDUSTRIAL SUPPLY AT A PAPERMILL NEAR ASHDOWN. THE AQUIFERS OF CRETACEOUS AGE ARE THE PRINCIPAL SOURCES OF FRESHWATER IN NORTHERN HEMPSTEAD AND NEVADA COUNTIES, WHERE WELLS YIELD AS MUCH AS 300 GPM OF GOOD QUALITY WATER FROM DEPTHS AS GREAT AS 1,200 FEET. AQUIFERS OF TERTIARY AGE ARE GOOD SOURCES OF WATER IN MILLER AND LAFAYETTE COUNTIES AND IN SOUTHEASTERN NEVADA COUNTY. TERRACE DEPOSITS OF QUATERNARY AGE ARE GOOD SOURCES OF WATER IN LITTLE RIVER AND LAFAYETTE COUNTIES. THE RED RIVER IS THE LARGEST SOURCE OF SURFACE WATER IN THE PROJECT AREA. IT DRAINS ABOUT 48,000 SQUARE MILES UPSTREAM FROM THE AREA AND HAS AN AVERAGE FLOW OF 12,180 CFS. THE PRINCIPAL RESERVOIRS IN THE AREA ARE MILLWOOD RESERVOIR ON LITTLE RIVER (CAPACITY, 1,858,000 ACRE-FEET) AND LAKE ERLING ON BODCAU CREEK (CAPACITY, 49,000 ACRE-FEET). MORE THAN 5,500 LAKES AND FARM PONDS OF 5 ACRES OR LESS HAVE A COMBINED STORAGE CAPACITY OF MORE THAN 14,000 ACRE-FEET. WATER IN THE RED RIVER IS HIGH IN CHLORIDE AND DISSOLVED SOLIDS AND, CONSEQUENTLY, IS CHEMICALLY UNSUITABLE FOR MOST USES UNLESS TREATED. (WOODARD-USGS)

Logs and water-level measurements of selected test holes and wells in the alluvium of the Arkansas River valley between Little Rock and Fort Smith, Arkansas
May, J. R., and Emmett, L. F., June 1964
U.S. Geological Survey Open-File Report, Volume I through XI

Logs and water-level measurements of selected test holes and wells in the alluvium of the Arkansas River valley between Little Rock, and Fort Smith, Arkansas
May, J. R., and Emmett, L. F., June 1964
U.S. Geological Survey Open-File Report, Volume XII

Chemical analyses of the water from selected wells in the Arkansas River Valley from the mouth to Fort Smith, Arkansas
May, J. R., Yanchosek, J. J., and Jeffery, H. G., June 1964
U.S. Geological Survey Open-File Report

Logs of Test Holes and Wells in the Red River Valley in Lafayette, Little River, and Miller Counties, Arkansas
May, J. R., Emmett, L. F., and Ludwig, A. H., 1965
U.S. Geological Survey Open-File Report 65-100

GEOHYDROLOGIC SIGNIFICANCE OF LITHOFACIES OF THE CARRIZO SAND OF ARKANSAS, LOUISIANA, AND TEXAS AND THE MERIDIAN SAND OF MISSISSIPPI
PAYNE, J. N.
GEOLOGICAL SURVEY, BATON ROUGE, LA.
AVAILABLE FROM SUPT. OF DOCUMENTS, GPO WASH., D.C. 20402, PRICE $11.00. GEOLOGICAL SURVEY PROFESSIONAL PAPER 569-D, 1975. 11 P, 2 FIG, 9 PLATES, 1 TAB, 60 REF.,
Journal Announcement: SWRA0915

THE STUDY OF THE CARRIZO AND MERIDIAN SANDS IS THE FOURTH PART OF AN INVESTIGATION OF THE GEOHYDROLOGY OF THE CLAIBORNE GROUP. THE REGIONAL DIP OF THE CARRIZO AND MERIDIAN SANDS IS INTO THE DESHA BASIN, MISSISSIPPI EMBAYMENT, AND GULF COAST GEOSYNCLINE. SOME MOVEMENT OF MAJOR STRUCTURAL FEATURES TOOK PLACE DURING CARRIZO AND MERIDIAN TIME. NORMAL FAULTING IS RATHER EXTENSIVE IN SOUTHERN ARKANSAS AND IN TEXAS. THE THICKNESS OF THE CARRIZO AND MERIDIAN SANDS VARIES FROM 0 IN AREAS OF NONDEPOSITION TO A MAXIMUM OF 700-750 FEET IN DE WITT AND KARNES COUNTIES, TEX. AQUIFER TESTS INDICATE THAT THE COEFFICIENT OF PERMEABILITY INCREASES WITH INCREASE IN SAND-UNIT THICKNESS, BUT THE RANGE IN VALUES IN THE CARRIZO AND MERIDIAN SANDS IS NOT AS GREAT AS THE RANGE IN VALUES FOUND IN THE OTHER CLAIBORNE AQUIFER FORMATIONS. THE AREAS OF HIGHEST TRANSMISSIVITY OF THE FORMATIONS ARE IN WEST-CENTRAL MISSISSIPPI AND IN SOUTHERN TEXAS. IN MISSISSIPI AND TEXAS THE DOMINANT ANION IS BICARBONATE IN WATER FROM THE CARRIZO AND MERIDIAN SANDS FROM DEPTHS OF 1,700 TO MORE THAN 2,500 FEET. IN ARKANSAS AND LOUISIANA, CHLORIDE IS THE DOMINANT ANION BELOW DEPTHS OF 500-1,00 FEET. (WOODARD-USGS)

### HYDROLOGIC SIGNIFICANCE OF LITHOFACIES OF THE CANE RIVER FORMATION OR EQUIVALENTS OF ARKANSAS, LOUISIANA, MISSISSIPPI, AND TEXAS

PAYNE, J. N.

GEOLOGICAL SURVEY, WASHINGTON, D.C.

AVAILABLE FROM GPO, WASHINGTON, DC 20402 - PRICE $10.90. GEOLOGICAL SURVEY PROFESSIONAL PAPER 569-C, 1972. 17 P, 4 FIG, 16 PLATE (BOUND SEPARATELY), 1 TAB, 61 REF.,

Journal Announcement: SWRA0619

THE STUDY OF THE CANE RIVER FORMATION AND ITS EQUIVALENTS IS PART OF AN INVESTIGATION OF THE GEOHYDROLOGY OF THE CLAIBORNE GROUP OF THE GULF COASTAL PLAIN. THE THICKNESS OF THE CANE RIVER FORMATION RANGES FROM 70 FEET IN LA SALLE PARISH, LA., TO 750 FEET IN THE DESHA BASIN OF ARKANSAS. THE COEFFICIENT OF PERMEABILITY PROBABLY INCREASES WITH INCREASE IN THICKNESS. RECHARGE OF THE CANE RIVER IS MAINLY BY PRECIPITATION IN THE OUTCROP AREA, BUT A MINOR AMOUNT OF RECHARGE TAKES PLACE BY THE UPWARD MOVEMENT OF WATER FROM THE UNDERLYING MERIDIAN-UPPER WILCOX AQUIFER. REGIONAL FLOW OF WATER IS GENERALLY DOWN THE DIP. IN AND NEAR THE OUTCROP AREA, WATER FROM THE CANE RIVER FORMATION CONTAINS PROPORTIONATELY HIGH CONCENTRATIONS OF CALCIUM AND MAGNESIUM. FARTHER DOWNDIP, SODIUM IS THE DOMINANT CATION. IN MISSISSIPPI THE DOMINANT ANION IS BICARBONATE. IN ARKANSAS AND LOUISIANA THE CHLORIDE ANIO N OCCURS IN SIGNIFICANT PROPORTIONS. RECHARGE OF THE REKLAW AND QUEEN CITY FORMATIONS TAKES PLACE BY INFILTRATION OF PRECIPITATION IN THE OUTCROP AREA, BY INFILTRATION OF WATER FROM STREAMS, AND BY UPWARD MOVEMENT OF WATER FROM THE CARRIZO SAND. THE DISTRIBUTION OF SOLUTES REFECLTS THE EXTENT OF FLUSHING BY FRESHWATER. (KNAPP-USGS)

### Reconnaissance of Stormwater-Runoiff Water Quality of the Big Piney Creek Segment of the Cedar-Piney Creeks Watershed, Yell County, Arkansas

Petersen, James E.

U.S. Geological Survey Open-File Report 82-761

A reconnaissance of the Big Piney Creek watershed was conducted between June 1981 and January 1982 to assess the water-quality of selected streams in the watershed. Streamflow was measured and water samples were collected three times at each of three sites during the study. All samples were collected during periods of stormwater runoff. The water was soft (7 to 20 milligrams per liter of hardness as calcium carbonate) and dissolved-solids concentrations ranged from 36 to 74 milligrams per liter. Suspended-sediment concentrations ranged from 7 to 144 milligrams per liter. The 5-day biochemical oxygen-demands, total-nitrogen concentrations and total-phosphorus concentrations ranged from 1.5 to 6.8 milligrams per liter, 0.54 to 5.8 milligrams per liter, and 0.03 to 0.56 milligram per liter, respectively. Fecal-coliform bacteria were present in large enough concentrations at two of the sites (340 to 490 colonies per 100 milliliters and 1,200 to 6,000 colonies per 100 milliliters) to indicate that the U.S. Environmental Protection Agency criterion for bathing waters and the Arkansas water-quality standard may be exceeded at times. Total-iron concentrations greater than 1,000 micrograms per liter (the U.S. Environmental Protection Agency criterion for protection of freshwater aquatic life) were detected at least once at all sites.

WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS
PLEBUCH, RAYMOND O.; HINES, MARION S.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
AVAIL FROM SUPERINTENDENT OF DOC, US GOVERNMENT PRINTING OFFICE, WASH, DC, 20402. GEOL SURV WATER-SUPPLY PAP 1879-A, P A1-A32, 1969. 32 P, 2 FIG, 1 PLATE, 8 TAB, 27 REF.,
Journal Announcement: SWRA0306

CLARK, CLEVELAND, AND DALLAS COUNTIES CONSTITUTE AN AREA OF 2,151 SQUARE MILES IN SOUTH-CENTRAL ARKANSAS. THE AREA IS DRAINED BY THE OUACHITA, SALINE, AND LITTLE MISSOURI RIVERS AND THEIR TRIBUTARIES. THE AMOUNT OF WATER AVAILABLE FOR USE CAN BE INCREASED BY THE CONSTRUCTION OF RESERVOIRS. SECOND PER SQUARE MILE, OR A TOTAL OF ABOUT 3,000 CFS. GENERALLY, THE WATER QUALITY IS GOOD; BUT WATER FROM SOME OF THE STREAMS, PARTICULARLY FROM THE SMALLER TRIBUTARIES, MAY REQUIRE TREATMENT FOR EXCESSIVE IRON CONTENT AND HIGH COLOR. THE CONSOLIDATED ROCKS IN THE INTERIOR HIGHLANDS GENERALLY YIELD LESS THAN 10 GPM TO WELLS, PRECLUDING THE DEVELOPMENT OF LARGE MUNICIPAL OR INDUSTRIAL GROUNDWATER SUPPLIES IN THAT AREA. THE FORMATIONS OF TERTIARY AGE OFFER THE BEST POSSIBILITIES FOR GROUNDWATER, PARTICULARLY IN DALLAS AND CLEVELAND COUNTIES. THE SPART ASAND IS THE BEST AQUIFER IN THE PROJECT AREA, PARTICULARLY EAST OF CENTRAL DALLAS COUNTY. WELL YIELDS OF 700 GALLONS PER MINUTE OR MORE ARE POSSIBLE. THE DEPOSITS OF QUATERNARY AGE ARE THIN AND GENERALLY SUITABLE ONLY FOR DOMESTIC SUPPLIES. TOTAL WATER USE IN THE PROJECT AREA IN 1965 WAS ABOUT 0.6 MILLION GALLONS PER DAY SINCE SURFACE-WATER SOURCES. TOTAL WATER USE IN THE AREA IN 1967 WAS INSIGNIFICANT COMPARED WITH THE TOTAL WATER AVAILABLE. (KNAPP-USGS)

WATER RESOURCES OF PULASKI AND SALINE COUNTIES, ARKANSAS
PLEBUCH, RAYMOND O.; HINES, MARION S.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
GEOL SURV WATER-SUPPLY PAP 1839-B, P B1-B25, 1967. 25 P, 2 FIG, 1 PLATE, 5 TAB, 27 REF.,
Journal Announcement: SWRA0223

PULASKI AND SALINE COUNTIES CONSTITUTE AN AREA OF 1,506 SQ MI IN THE GEOGRAPHIC CENTER OF ARKANSAS. THE AREA IS DIVIDED INTO A HILLY WESTERN PART, KNOWN AS THE INTERIOR HIGHLANDS, AND A RELATIVELY FLAT EASTERN PART, KNOWN AS THE COASTAL PLAIN. IN THE INTERIOR HIGHLANDS, SURFACE WATER OFFERS GREATER POSSIBILITIES THAN GROUNDWATER FOR WATER SUPPLIES.

ALUM FORK, MIDDLE FORK, AND NORTH FORK OF THE SALINE RIVER OFFER EXCELLENT IMPOUNDMENT STORAGE, MANY OF THE SMALLER STREAMS ARE SUITABLE FOR DEVELOPMENT OF SMALL SUPPLIES. IN CONTRAST, IN THE COASTAL PLAIN IT IS EASIER TO DEVELOP GROUNDWATER THAN SURFACE WATER IN RELATIVELY LARGE QUANTITIES. TWO AQUIFERS, UNITS 3 AND 9, YIELD AS MUCH AS 350 AND 2,000 GPM OF WATER, RESPECTIVELY. A THIRD AQUIFER, UNIT 7, IS AS YET RELATIVELY UNDEVELOPED IN THE PROJECT AREA, BUT YIELDS 860 GPM TO A WELL SOUTH OF THE PROJECT AREA. THESE AQUIFERS YIELD WATER THAT, WITH TREATMENT, IS SUITABLE FOR MOST USES. (KNAPP-USGS)

Digital Model of the Bayou Bartholomew Alluvial Aquifer-Stream System, Arkansas
Reed, J. E., and Broom, M. E., 1979
U.S. Geological Survey Open-File Report 79-685

A digital model of the aquifer-stream system was calibrated for the purpose of predicting hydrologic responses to stresses of water development. The simulated-time span for model calibration was from 1953 to 1970, during which time the system was stressed largely by ground- and surface-water diversions for rice irrigation.

The model was calibrated by comparing ground-water-level and streamflow data with model-derived ground-water levels and streamflow. In the calibrated model, the ratio of model-derived to observed streamflows for 17 subbasins averaged 1.1; the ratios among the subbasins ranged from 0.8 to 1.6. The average deviation of the differences between model-derived and observed ground-water levels at 47 nodes was 0.2; the average among the nodes ranged from 2.3 to 10.4. The average standard deviation of the differences between the model-derived and observed ground-water levels was 3.5; the average among the nodes ranged from 0.4 to 10.5.

The model will provide projections of changes in the potentiometric surface resulting from (1) changes in the rate or distribution of ground-water pumpage or (2) changes in the stage of streams and reservoirs. The model will provide only approximate projections of the streamflow.

Waste-load allocation studies for Arkansas streams, Ouachita River basin, Saline River, Segment 2C
Reed, J. E., Lambert, B. F., Morris, E. E., and Stephens, J. W., 1974
U.S. Geological Survey Open-File Report

Waste-load allocation studies for Arkansas streams, Ouachita River basin, Bayou Bartholomew, Segment 2B
Reed, J. E., Terry, J. E., Lambert, B. F., and Morris, E. E., 1975
U.S. Geological Survey Open-File Report

Waste-load allocation studies for Arkansas streams, Ouachita

River basin, Segment 2D
Reed, J. E., Terry, J. E., Stephens, J. W., and Bryant, C. T., 1975
U.S. Geological Survey Open-File Report

Low-flow characteristics of streams in the Mississippi embayment in northern Arkansas and in Missouri
Speer, P. R., Hines, M. S., Janson, M. E., and others, 1966
U.S. Geological Survey Professional Paper 448-F

A STUDY OF THE CHEMICAL QUALITY OF STREAMFLOW IN ARKANSAS
STEELE, T. D.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
GEOLOGICAL SURVEY OPEN-FILE REPORT, OCTOBER 1971. 93 P, 8 FIG, 26 TAB, 9 REF.,
Journal Announcement: SWRA0510

HISTORICAL RECORDS OF STREAMFLOW CHEMICAL QUALITY OF 16 ARKANSAS WATER QUALITY STATIONS, REPRESENTING MORE THAN 102 STATION-YEARS OF DATA AND OVER 6200 COMPOSITED SAMPLES, ARE ANALYZED GRAPHICALLY AND STATISTICALLY. A SEQUENTIAL PROCEDURE IS DESCRIBED FOR ANALYZING DATA. A SUMMARY FOR EACH SAMPLING STATION INCLUDES BASIC STATISTICS FOR THE PERIOD OF RECORD, PLOTS OF SELECTED DATA PAIRS, AND REGRESSION RELATIONSHIPS DERIVED FROM THE HISTORICAL WATER-QUALITY DATA AVAILABLE FOR THAT LOCATION. A TECHNIQUE IS SHOWN FOR SIMULATING CONCENTRATIONS AND LOADS OF MAJOR INORGANIC SOLUTES USING SUPPLEMENTAL RECORDS OF SPECIFIC CONDUCTANCE, STREAM DISCHARGE, AND APPLICABLE CONCENTRATION-CONDUCTANCE REGRESSION EQUATIONS. PRELIMINARY SIMULATION STUDIES REVEALED THAT MONTHLY MEAN VALUES COULD BE ESTIMATED TO WITHIN 15-25% OF ACTUAL DETERMINATIONS FOR AN INDEPENDENT PERIOD OF RECORD OR SET OF DATA. ANNUAL MEAN CONCENTRATIONS AND LOADS FOR DOMINANT IONS ESTIMATED FROM THE REGRESSION RELATIONSHIPS SELDOM EXCEEDED 15% IN ERROR RELATIVE TO COMPARABLE VALUES COMPUTED FROM ACTUAL DATA. OTHER PROCEDURES IN DATA ANALYSIS INCLUDE EXAMPLES FROM TRANSFERRING INFORMATION ON STREAMFLOW CHEMICAL QUALITY BOTH IN TIME AND SPACE AND FOR ASSESSING LONG-TERM TRENDS IN STREAMFLOW SALINITY. (WOODARD-USGS)

WELL RECORDS, DEPTH-TO-WATER MEASUREMENTS, CHEMICAL ANALYSES OF GROUND WATER, DRILLERS LOGS, AND ELECTRIC-LOG INFORMATION IN HEMPSTEAD, LAFAYETTE, LITTLE RIVER, MILLER, AND NEVADA COUNTIES, ARKANSAS
STEPHENS, J. W.
GEOLOGICAL SURVEY, LITTLE ROCK, ARK.
GEOLOGICAL SURVEY REPORT, 1970. 197 P, 6 FIG, 25 TAB.,
Journal Announcement: SWRA0412

THIS REPORT IS A COMPILATION OF HYDROGEOLOGIC DATA COLLECTED DURING A WATER-RESOURCES INVESTIGATION OF HEMPSTEAD, LAFAYETTE, LITTLE RIVER, MILLER, AND NEVADA COUNTIES, ARKANSAS. THE DATA HAVE BEEN PREPARED FOR USE IN PLANNING WATER-RESOURCES DEVELOPMENT IN THE AREA. MOST OF DATA WERE COLLECTED BETWEEN

JANUARY 1967 AND OCTOBER 1968, AND INCLUDES RECORDS OF 479 WELLS AND TEST HOLES; RESULTS OF CHEMICAL ANALYSES OF WATER SAMPLES FROM 197 WELLS; ELECTRIC-LOG INFORMATION FROM 131 LOCATIONS; LITHOLOGIC LOGS OF 126 WELLS AND TEST HOLES; AND MEASUREMENT OF WATER LEVELS IN 149 WELLS. (WOODARD-USGS)

Floodflow characteristics of Mulberry River at Interstate 40, near Mulberry, Arkansas
Sullavan, J. N., 1976
U.S. Geological Survey Open-File Report 76-179

Water-Resources Appraisal of the South-Arkansas Lignite Area
Terry, J. E.; Bryant, C. T.; Ludwig, A. H.; Reed, J. E.
Geological Survey, Little Rock, AR. Water Resources Div.
Geological Survey Open-File Report 79-924, May, 1979. 162 p, 36 Fig, 50 Tab, 46 Ref, 1 Plate.,
Journal Announcement: SWRA1410

The feasilbility of developing lignite resources in south-central Arkansas is an important question at the present time (1978). Part of the concern is related to the possible impacts that mining and processing of lignite will have on water resources. Not only will the disturbance caused by excavating affect the quantity and quality of surface and ground water, but the mining, processing, and conversion processes will require the use and consumption of significant quantities of water. To assess the magnitude of the effects of strip mining upon both surface and ground water, baseline conditions (hydrologic conditions in the area prior to mining) must be well defined. A thorough data file and literature search was made so that baseline conditions in the area could be defined. In addition, data-collection networks have been established for the collection of quantitative and qualitative information on streamflow and water levels in the aquifers. Data collected to date at these sites are included in the report. Collection of data at these sites will continue through at least September 1979. Information presented in this report can be used to estimate the quantities of water available for use and the possible effects of mining and associated dewatering on water resources. (USGS)

Waste-load allocation studies for Arkansas streams, White River basin, Segment 4A
Terry, J. E., Lambert, B. F., Morris, E. E., and Ludwig, A. H., 1975
U.S. Geological Survey Open-File Report

Waste-load allocation studies for Arkansas streams, Ouachita River basin, Boeuf River and Bayou Macon, Segment 2A
Terry, J. E., Morris, E. E., Lambert, B. F., and Sniegocki, R. T., 1975
U.S. Geological Survey Open-File Report

Waste-load allocation Studies for Arkansas streams Ouachita River basin, Segment 2E
Terry, J. E., Morris, E. E., and Stephens, J. W., 1975
U.S. Geological Survey Open-File Report

Well Records, Water-Level Measurements, Logs of Test Holes, and Chemical Analyses of Ground Water in the Cache River Alluvial Aquifer-Stream System, Northeast Arkansas, 1946-76
Westerfield, P. W.
Geological Survey, Little Rock, Ark. Water Resources Div.
Open-file Report 77-402, May 1977. 166 p, 2 fig, 57 tab.,
Journal Announcement: SWRA1024

Most of the ground-water data for the Cache River alluvial aquifer-stream system in northeast Arkansas were collected between March 1973 and April 1976, but some were collected as early as April 1946. The data includes records of 363 wells and test holes, water-level measurements of 295 wells, logs of 32 test holes, and chemical analyses of water samples from 85 wells. (Woodard-USGS)

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1969: PART 7. LOWER MISSISSIPPI RIVER BASIN
GEOLOGICAL SURVEY, RESTON, VA.
AVAILABLE FROM SUPT. OF DOCUMENTS, GPO, WASH., D.C. 20402, PRICE $3.85. WATER-SUPPLY PAPER 2146, 1974. 540 P, 1 FIG, 40 REF.,
Journal Announcement: SWRA0909

DURING THE WATER YEAR ENDING SEPTEMBER 30, 1969, THE GEOLOGICAL SURVEY MAINTAINED 259 STATIONS ON 156 STREAMS IN THE LOWER MISSISSIPPI RIVER BASIN FOR THE STUDY OF CHEMICAL AND PHYSICAL CHARACTERISTICS OF SURFACE WATER. SAMPLES WERE COLLECTED DAILY AND MONTHLY AT 235 OF THESE LOCATIONS FOR CHEMICAL-QUALITY STUDIES. SAMPLES ALSO WERE COLLECTED LESS FREQUENTLY AT MANY OTHER POINTS. WATER TEMPERATURES WERE MEASURED CONTINUOUSLY AT 28 AND DAILY AT 79 STATIONS. DAILY WATER TEMPERATURES WERE MEASURE AT MOST OF THE STATIONS AT THE TIME SAMPLES WERE COLLECTED FOR CHEMICAL QUALITY OR SEDIMENT CONTENT. SO FAR AS PRACTICABLE, THE WATER TEMPERATURES WERE TAKEN AT ABOUT THE SAME TIME EACH DAY. QUANTITIES OF SUSPENDED SEDIMENT ARE REPORTED FOR 19 STATIONS. SEDIMENT SAMPLES WERE COLLECTED ONE OR MORE TIMES DAILY AT MOST STATIONS, DEPENDING ON THE RATE OF FLOW AND CHANGES IN STAGE OF THE STREAM. PARTICLE-SIZE DISTRIBUTIONS OF SEDIMENTS WERE DETERMINED AT 19 STATIONS. THE STREAM DISCHARGE REPORTED FOR A COMPOSITE SAMPLE IS USUALLY THE AVERAGE OF DAILY MEAN DISCHARGES FOR THE COMPOSITE PERIOD. THE DISCHARGES REPORTED IN THE TABLES OF SINGLE ANALYSES ARE EITHER DAILY MEAN DISCHARGES OR DISCHARGES OBTAINED AT THE TIME SAMPLES WERE COLLECTED AND COMPUTED FROM A STAGE-DISCHARGE RELATION OR FROM A DISCHARGE MEASUREMENT. (WOODARD-USGS)

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1970: PART 7. LOWER MISSISSIPPI RIVER BASIN
GEOLOGICAL SURVEY, RESTON, VA.
AVAILABLE FROM SUPT OF DOCUMENTS, GPO, WASHINGTON, DC 20402 PRICE $5.25. WATER-SUPPLY PAPER 2156, 1975. 636 P, 1 FIG, 41 REF.,
Journal Announcement: SWRA0823

DURING THE WATER YEAR ENDING SEPTEMBER 30, 1970, THE GEOLOGICAL SURVEY MAINTAINED 289 STATIONS ON 167 STREAMS IN THE LOWER MISSISSIPPI RIVER BASIN FOR THE STUDY OF CHEMICAL AND PHYSICAL CHARACTERISTICS OF SURFACE WATER. SAMPLES WERE COLLECTED DAILY AND MONTHLY AT 274 OF THESE LOCATIONS FOR CHEMICAL-QUALITY STUDIES. SAMPLES ALSO WERE COLLECTED LESS FREQUENTLY AT MANY OTHER POINTS. WATER TEMPERATURES WERE MEASURED CONTINUOUSLY AT 17 AND DAILY AT 82 STATIONS. DAILY WATER TEMPERATURES WERE MEASURED AT MOST OF THE STATIONS AT THE TIME SAMPLES WERE COLLECTED FOR CHEMICAL QUALITY OR SEDIMENT CONTENT. SO FAR AS PRACTICABLE, THE WATER TEMPERATURES WERE TAKEN AT ABOUT THE SAME TIME EACH DAY. QUANTITIES OF SUSPENDED SEDIMENT ARE REPORTED FOR 15 STATIONS DURING THE YEAR ENDING SEPTEMBER 30, 1970. SEDIMENT SAMPLES WERE COLLECTED ONE OR MORE TIMES DAILY AT MOST STATIONS, DEPENDING ON THE RATE OF FLOW AND CHANGES IN STAGE OF THE STREAM. PARTICLE-SIZE DISTRIBUTIONS OF SEDIMENTS WERE DETERMINED AT 15 STATIONS. THE STREAM DISCHARGE REPORTED FOR A COMPOSITE SAMPLE IS USUALLY THE AVERAGE OF DAILY MEAN DISCHARGES FOR THE COMPOSITE PERIOD. THE DISCHARGES REPORTED IN THE TABLES OF SINGLE ANALYSES ARE EITHER DAILY MEAN DISCHARGES OR DISCHARGES OBTAINED AT THE TIME SAMPLES WERE COLLECTED AND COMPUTED FROM A STAGE-DISCHARGE RELATION OR FROM A DISCHARGE MEASUREMENT. (WOODARD-USGS)

Water Resources Data for Arkansas, published annually since 1975.
Geological Survey, Little Rock, AR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161.

Water resources data for Arkansas consist of records of stage, discharge, and water quality of streams; and stage, contents, and water quality of lakes and reservoirs. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Arkansas. (USGS)

Coal resource occurrence and coal development potential maps of the Eagle Hill quadrangle, Jackson and Larimer Counties, Colo.
AAA Engineering and Drafting, Inc., 1980a
U.S. Geological Survey Open-File Report 79-188, 24 p., 9 oversize sheets, scale 1:24,000.

Coal resource occurrence and coal development potential maps of Gould NW quadrangle, Jackson County, Colorado
AAA Engineering and Drafting, Inc., 1980b
U.S. Geological Survey Open-File Report 79-191, 25 p., 11 oversize sheets, scale 1:24,000.

Coal resource occurrence and coal development potential maps of Johnny Moore Mountain quadrangle, Jackson County, Colorado
AAA Engineering and Drafting, Inc., 1980c
U.S. Geological Survey Open-File Report 79-192, 21 p., 9 oversize sheets, scale 1:24,000.

Coal resource occurrence and coal development potential maps of MacFarlane Reservoir quadrangle, Jackson County, Colorado
AAA Engineering and Drafting, Inc., 1980d
U.S. Geological Survey Open-File Report 79-193, 25 p., 9 oversize sheets, scale 1:24,000.

Coal resource occurrence and coal development potential maps of Cowdrey quadrangle, Jackson County, Colorado
AAA Engineering and Drafting, Inc., 1980e
U.S. Geological Survey Open-File Report 79-196, 21 p., 7 oversize sheets, scale 1:24,000.

Coal resource occurrence and coal development potential maps of Coalmont quadrangle, Jackson County, Colorado
AAA Engineering and Drafting, Inc., 1980f
U.S. Geological Survey Open-File Report 79-1417, 34 p., 13 oversize sheets, scale 1:24,000.

Reconnaissance Evaluation of Water Resources for Hydraulic Coal Mining, Grand Hogback Coal Field, Garfield and Rio Blanco Counties, Colorado
Alley, W. M.; Britton, L. J.; Boyd, E. L.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the USGS, OFSS Box 25425, Den. Fed. Ctr. Denver CO 80225 paper copy $6.00, microfiche $3.50. Geological Survey open-file report 78-885, November 1978. 37 p, 9 fig, 8 tab, 20 ref.,

Journal Announcement: SWRA1212

Surface-water and ground-water data were compiled for the parts of the Colorado River and the White River basins in and adjacent to the Grand Hogback coal field. The data were evaluated to assess the quantity and quality of water resources available in the area for use in hydraulic coal mining. Based on discharge records, surface-water supplies of most streams should be adequate to meet the demands for hydraulic mining of 1 million tons of coal per year with a recycled water system. However, on some of the smaller streams in the area, some storage of water may be required for use during low-flow periods to meet minimum-flow requirements for downstream reaches. Other potential sources of water include Rifle Gap Reservoir, Harvey Gap Reservoir, and ground water from valley-fill deposits along major streams and rivers. The surface water and ground water should be of adequate quality for use in hydraulic mining, with the possible exceptions of suspended-sediment concentrations that periodically may be as much as 18,800 milligrams per liter in streams in the Rifle Creek drainage, and dissolved-solids concentrations greater than 20,000 milligrams per liter in some aquifers. Data are insufficient to assess the potential impact of hydraulic coal mining on downstream water quality. (Woodard-USGS)

Reconnaissance Evaluation of Water Resources for Hydraulic Coal Mining, Crested Butte Coal Field, Gunnison County, Colorado

Alley, W. M.; Britton, L. J.; Boyd, E. L.

Geological Survey, Lakewood, CO. Water Resources Div.

Availability: OFSS, USGS Box 25425, Den. Fed. Ctr. Denver, CO. 80225 microfiche $3.50, paper copy $3.75. Geological Survey open-file report 78-938, December 1978. 23 p, 6 fig, 6 tab, 20 ref.,

Journal Announcement: SWRA1212

Available surface-water and ground-water data were compiled for the parts of the Gunnison River basin in and adjacent to the Crested Butte coal field. The data were evaluated to assess the quantity and quality of water resources in the area for use in hydraulic coal mining. Based on discharge records, surface-water supplies of most streams should be adequate to meet the demands for hydraulic mining of 1 million tons of coal per year with a recycled water system. However, on some of the smaller streams in the area, some storage of water may be required for use during low-flow periods to meet minimum-flow requirements for downstream reaches. Other potential sources of water for hydraulic coal mining include ground water from alluvium along major streams and from the Dakota and Entrada Sandstones. The surface and ground water in the study area should be of adequate quality for use in hydraulic coal mining, with the possible exception of Coal Creek which has excessive concentrations of iron, manganese, and zinc. Data are insufficient to assess the potential impact of hydraulic coal mining on downstream water quality. (Woodard-USGS)

Present and Potential Sediment Yields in the Yampa River Basin, Colorado and Wyoming, (Duplicated see Wyoming).
Andrews, E. D.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-292 677, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-105, December 1978. 33 p, 10 fig, 4 tab, 32 ref.,
Journal Announcement: SWRA1214
Average annual suspended- and total-sediment loads in streamflow were determined by the flow-duration sediment-transport-curve method at 18 sites in the Yampa River basin, Colorado and Wyoming. These computations indicate that about 2.0 million tons of sediment are carried by the Yampa River at Deerlodge Park during an average year. Significant areal differences in the sediment yield from various parts of the basin also were determined. The lower Little Snake River subbasin contributes about 60 percent of the total basin sediment yield, although it represents less than 35 percent of the area and supplies less than 3 percent of the streamflow. In contrast, the upland (eastern) one-third of the basin contributes only about 14 percent of the sediment yield but 76 percent of the streamflow. Projected economic development of the basin, especially surface mining of coal, will impact the physical environment. Depending upon the amount and location of land disturbed, an estimated 10,000 to 30,000 tons per year of additional sediment will be contributed to the main-stem Yampa River. (Woodard-USGS)

MAP SHOWING AVAILABILITY OF HYDROLOGIC DATA PUBLISHED AS OF 1974 BY THE U.S. ENVIRONMENTAL DATA SERVICE AND BY THE U.S. GEOLOGICAL SURVEY AND COOPERATING AGENCIES, COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO
ANNA, L. O.
GEOLOGICAL SURVEY, DENVER, COLO.
FOR SALE USGS, RESTON, VA 22092, PRICE $0.75. MISCELLANEOUS INVESTIGATIONS SERIES MAP I-857-D, 1975. 1 SHEET, 1 MAP, 26 REF.,
Journal Announcement: SWRA0902
THIS MAP SHOWS BY SYMBOLS AND COLOR THE HYDROLOGIC DATA PUBLISHED AS OF JANUARY 1974 FOR THE COLORADO SPRINGS-CASTLE ROCK COLO., AREA BY THE U.S. ENVIRONMENTAL DATA SERVICE AND BY THE U.S. GEOLOGICAL SURVEY AND COOPERATING AGENCIES. ALL SOURCES OF THE DATA ARE GIVEN IN THE REFERENCES AND ARE REFERRED TO IN THE DISCUSSION. OF THE 44 CLIMATOLOGICAL STATIONS SHOWN THE LONGEST PRECIPITATION RECORDS ARE FOR FOUNTAIN, COLO., BEGINNING IN 1866. COLORADO SPRINGS' PRECIPITATION RECORDS BEGIN IN 1871. SURFACE-WATER DATA INCLUDE CONTINUOUS RECORDS OF STAGE AND DISCHARGE OF STREAMS. LOCATION OF 16 SURFACE-WATER DATA SITES ARE SHOWN; INCLUDED ARE 7

CONTINUOUS-RECORD STREAM-STAGE AND DISCHARGE STATIONS, AND 4 STAFF-GAGE STREAM DISCHARGE SITES. STREAMFLOW RECORDS WERE COLLECTED AS EARLY AS 1908. GROUNDWATER DATA SITES PLOTTED ON THE MAP REPRESENT 40 WELLS WHERE WATER LEVELS HAVE BEEN MEASURED PERIODICALLY FOR 4 OR MORE YEARS OR MONTHLY FOR AT LEAST 1 YEAR, AND 49 WELLS FROM WHICH WATER SAMPLES HAVE BEEN ANALYZED FOR DISSOLVED-CHEMICAL CONSTITUENTS. (WOODARD-USGS)

LAND-USE CLASSIFICATION MAP OF THE COLORADO SPRINGS--CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO
B, L.; DRISCOLL,
GEOLOGICAL SURVEY, DENVER, COLO.
FOR SALE USGS, RESTON, VA., 22092, PRICE $1.75. MISCELLANEOUS INVESTIGATIONS SERIES MAP I-857-B, 1975. 1 SHEET, 1 MAP, 2 REF.,
Journal Announcement: SWRAU924

THE FRONT RANGE URBAN CORRIDOR OF COLORADO, FROM FORT COLLINS ON THE NORTH THROUGH FOUNTAIN ON THE SOUTH, IS AN AREA OF RAPID POPULATION GROWTH AND EXPANDING LAND DEVELOPMENT. THIS MAP PROVIDES FOR THE COLORADO SPRINGS-CASTLE ROCK AREA THE FIRST STEP TOWARD COMPATIBLE LAND USES IN THE FUTURE--A COMPREHENSIVE PICTURE OF THE DISTRIBUTION OF DIFFERENT LAND CLASSES AND AN IMPLICATION ABOUT THE PROPORTIONS OF VARIOUS USES. IF USED WITH MAPS SHOWING RESOURCES, SOIL TYPES, GEOLOGY, WATER AVAILABILTY, TOPOGRAPHY, DEMOGRAPHY, AND OTHER ATTRIBUTES, THIS LAND-CLASSIFICATION MAP HELPS TO SET LIMITATIONS ON USE OF THE LAND. ONCE THE LIMITATIONS ARE KNOWN, ZONING CAN HELP ASSURE LAND USES THAT ARE COMPATIBLE WITH THE NATURAL ENVIRONMENT--FOR EXAMPLE, THE ZONING OF FLOOD PLAINS FOR GREENBELT OR RECREATIONAL USE. (WOODARD-USGS)

Ground-water geology of parts of Laramie and Albany Counties Wyoming and Weld County, Colorado
Babcock, H. M., Bjorklund, L. J., and Kister, L. R., 1956
U.S. Geological Survey Water-Supply Paper 1367, 61 p.

Economic geology of Gilpin County and adjacent parts of Clear Creek and Boulder Counties, Colorado
Bastin, E. S., and Hill, J. M., 1917
U.S. Geological Survey Professional Paper 94, 376 p.

Analysis of waste-load assimilative capacity of the Yampa River, Steamboat Springs to Hayden, Routt County, Colorado
Bauer, D. P., Steele, T. D., and Anderson, R. D., 1978,
U.S. Geological Survey Water-Resources Investigations 77-119, 69 p.

Traveltime, unit-concentration, longitudinal-dispersion, and

reaeration characteristics of upstream reaches of the Yampa and Little Snake Rivers, Colorado and Wyoming
Bauer, D. P., Rathbun, R. E., and Lowham, H. W., 1978
U.S. Geological Survey Water-Resources Investigations 78-122, 73 p.

Geology and coal resources of North Park, Colorado
Beekly, A. L., 1915
U.S. Geological Survey Bulletin 596, 121 p.

WATER-LEVEL DECLINES AND GROUND-WATER QUALITY, UPPER BLACK SQUIRREL CREEK BASIN, COLORADO
BINGHAM, D. L.; KLEIN, J. M.
GEOLOGICAL SURVEY, DENVER, COLO.
COLORADO WATER RESOURCES CIRCULAR 23, 1973. 21 P, 7 FIG, 2 PLATE, 3 TAB, 12 REF.,
Journal Announcement: SWRA0708

GROUNDWATER RESOURCES ARE SUMMARIZED FOR THE ALLUVIAL AQUIFER OF THE UPPER BLACK SQUIRREL CREEK BASIN IN COLORADO. INCLUDED ARE GROUNDWATER LEVELS AND GROUNDWATER QUALITY DATA THAT WERE COLLECTED FROM 1970 TO 1972, AND SELECTED DATA FROM PREVIOUS STUDIES. THE ALLUVIAL AQUIFER CONSISTS OF WATER-BEARING GRAVEL, SAND, SILT, AND CLAY THAT OCCUPIES CHANNELS ERODED IN THE UNDERLYING FORMATIONS. GROUNDWATER-LEVEL DECLINES OF 10 FEET OR MORE IN A 15-SQUARE-MILE AREA AND DECLINES OF 20 TO 35 FEET OVER A 5-SQUARE-MILE AREA HAVE BEEN OBSERVED IN THE ALLUVIAL AQUIFER DURING 1964-71. THE SATURATED THICKNESS OF THE AQUIFER EXCEEDS 40 FEET IN ABOUT 40 SQUARE MILES OF THE 350-SQUARE-MILE BASIN. PRESENT TRENDS INDICATE A CONTINUED LOWERING CONCENTRATION LESS THAN 250 MG PER LITER, UNDERLIES THE CENTRAL PART OF THE BASIN. THE DISSOLVED-SOLIDS CONCENTRATION INCREASES LATERALLY FROM THE CENTRAL PART OF THE BASIN. (WOODARD-USGS)

GROUND-WATER OCCURRENCE IN NORTHERN AND CENTRAL PARTS OF WESTERN COLORADO
BOETTCHER, A. J.
GEOLOGICAL SURVEY, DENVER, COLO.
COLORADO WATER CONSERVATION BOARD WATER RESOURCES CIRCULAR NO 15, 1972. 25 P, 3 FIG, 6 PLATE, 7 TAB, 35 REF.,
Journal Announcement: SWRA0610

GROUNDWATER RESOURCES ARE DESCRIBED FOR A 29,000-SQUARE-MILE AREA IN WESTERN COLORADO. THE AREA INCLUDES ALL OR PARTS OF 15 COUNTIES AND IS DRAINED BY THE COLORADO, GUNNISON, WHITE, YAMPA, AND GREEN RIVERS. DATA SUMMARIES INCLUDE THE AVAILABILITY OF GROUNDWATER, THE CHEMICAL QUALITY OF GROUNDWATER, EXTENT OF CURRENT GROUNDWATER USE, AND PROBLEMS THAT ARE ASSOCIATED WITH MANAGING AND USING GROUNDWATER.

OTHER BASIC INFORMATION INCLUDES GEOLOGIC, LAND USE, SOILS, AND LAND STATUS (OWNERSHIP) MAPS. THE 35 REPORTS USED IN THE STUDY ARE SHOWN IN THE REFERENCES. GROUNDWATER SUPPLIES 18 OF THE 51 TOWNS IN THE AREA. FOUR TOWNS ARE SUPPLIED BY GROUND AND SURFACE WATER, AND 29 USE SURFACE WATER. ABOUS 28% OR 6.9 MGD OF THE 25 MGD WATER USED BY TOWNS IN 1970 WAS FROM WELLS AND SPRINGS, WHEREAS 72% OR 18.1 MGD WAS FROM STREAMS. GROUNDWATER IS WELL SUITED FOR DOMESTIC SUPPLIES BECAUSE WELL SYSTEMS ARE CHEAPER AND MORE SANITARY THAN MOST SMALL SURFACE-WATER SYSTEMS. DESPITE RATHER WIDESPREAD USE OF GROUNDWATER, ONLY 141 OF THE MORE THAN 4,000 WATER WELLS ARE REPORTED TO YIELD MORE THAN 100 GPM. (WOODARD-USGS)

SALT-LOAD COMPUTATIONS--COLORADO RIVER; CAMEO, COLORADO, TO CISCO, UTAH: PART 2. BASIC DATA
BRENNAN, R.; GROZIER, R. U.
GEOLOGICAL SURVEY, DENVER, COLO.
OPEN-FILE REPORT, 1976. 222 P, 54 FIG, 12 TAB.,
Journal Announcement: SWRA0919

BASIC DATA FOR THE SALT-LOAD COMPUTATIONS, COLORADO RIVER, CAMEO, COLO., TO CISCO, UTAH, CONSISTS OF REGRESSION CURVES OF DISCHARGE VERSUS SPECIFIC CONDUCTANCE AND SPECIFIC CONDUCTANCE VERSUS CALCIUM, MAGNESIUM, HARDNESS, SODIUM, BICARBONATE, CHLORIDE, DISSOLVED SOLIDS, AND SULFATE; DURATION TABLES OF DAILY DISCHARGE AND DAILY SPECIFIC CONDUCTANCE AT SIX STREAM-GAGING SITES; AND DAILY SPECIFIC-CONDUCTANCE DATA FOR THE PERIOD OF RECORD FOR ALL STATIONS IN THE STUDY AREA. LOCATION OF STREAMFLOW AND WATER-QUALITY STATIONS ARE SHOWN ON A MAP. (SEE ALSO W76-10142) (WOODARD-USGS)

SALT-LOAD COMPUTATIONS--COLORADO RIVER; CAMEO, COLORADO TO CISCO, UTAH: PART 1. DATA SUMMARY
BRENNAN, R.; GROZIER, R. U.
GEOLOGICAL SURVEY, DENVER, COLO.
OPEN-FILE REPORT, 1976. 15 P, 3 FIG, 6 TAB.,
Journal Announcement: SWRA0919

SALT-LOAD COMPUTATIONS FOR INFLOW AND OUTFLOW STATIONS IN THE GRAND VALLEY AREA OF COLORADO HAVE BEEN COMPUTED USING FIVE METHODS. THE SALT-LOAD INCREASE OF THE COLORADO RIVER FROM THE GRAND VALLEY HAS BEEN COMPUTED FOR THE COLORADO-UTAH STATE LINE STATION AND THE COLORADO RIVER NEAR CISCO, UTAH, STATION. MOST OF THE SALT LOADS GIVE VALUES ABOUT +30 PERCENT OF THE AVERAGE FOR ALL METHODS USED, BUT DIFFERENCES OF 70 PERCENT DO OCCUR. RECORDS PRESENTED IN THE BASIC-DATA REPORT ARE REGRESSION CURVES OF DISCHARGE VERSUS SPECIFIC CONDUCTANCE AND OF SPECIFIC CONDUCTANCE VERSUS CALCIUM, MAGNESIUM, HARDNESS, SODIUM, BICARBONATE, CHLORIDE, DISSOLVED SOLIDS, AND SULFATE; DURATION TABLES OF DAILY DISCHARGE AND OF DAILY SPECIFIC CONDUCTANCE FOR THE PERIOD OF RECORD; AND THE DAILY SPECIFIC-CONDUCTANCE DATA

FOR THE PERIOD OF RECORD FOR ALL STATIONS IN THE STUDY AREA. (SEE ALSO W76-10143) (WOODARD-USGS)

Reconnaissance Evaluation of Surface-Water Quality in Eagle, Grand, Jackson, Pitkin, Routt, and Summit Counties, Colorado

Britton, L. J.

Geological Survey, Lakewood, CO. Water Resources Div.

Available from OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, microficie $3.50, paper copy $38.00. Geological Survey open-file report 79-420, April 1979. 285 p, 9 Fig, 41 Tab, 106 Ref.,

Journal Announcement: SWRA1307

Water-quality data were collected from streams in a six-county area in northwest Colorado to determine if the streams were polluted and, if so, to determine the sources of the pollution. Eighty-three stream sites were selected for sampling in Eagle, Grand, Jackson, Pitkin, Routt, and Summit Counties. A summary of data collected prior to this study, results of current chemical and biological sampling, and needs for future water-quality monitoring are reported for each county. Data collected at selected sites included temperature, pH, specific conductance, dissolved oxygen, and stream discharge. Chemical data collected included nutrients, inorganics, organics, and trace elements. Biological data collected included counts and species composition of total and fecal-coliform bacteria, fecal-streptococcus bacteria, benthic invertebrates, and phytoplankton. Most of the sites were sampled three times: in April-June 1976, August 1976, and January 1977. (Woodard-USGS)

Availability and Chemical Characteristics of Ground Water in Central La Plata County, Colorado

Brogden, R. E.; Giles, T. F.

Geological Survey, Lakewood, CO. Water Resources Div.

Water-Resources Investigations 76-69 (open-file report), May 1976. 1 sheet, 14 ref.,

Journal Announcement: SWRA1107

The central part of La Plata County, Colo., has undergone rapid population growth in recent years. This growth has resulted in an increased demand for information for additional domestic, industrial, and municipal water supplies. A knowledge of the occurrence of ground water will permit a more efficient allocation of the resource. Aquifers in central La Plata County include: alluvium, Animas Formation of Quaternary and Tertiary age, Fruitland Formation, Pictured Cliffs Sandstone, three formations of the Mesa Verde Group, the Mancos Shale, Dakota Sandstone, Morrison Formation of Cretaceous and Jurassic age, and undifferentiated formations. Well yields generally are low, usually less than 25 gallons per minute. However, higher yields, 25 to 50 gallons per minute may be found locally in aquifers in the alluvium and the Animas Formation.

The quality of water from the aquifers is dependent on rock type. Most of the water is a calcium bicarbonate type. However, aquifers that are predominantly fine-grained or contain interbeds of shale may contain sodium bicarbonate type water. The dissolution of minerals in the coal beds, which are present in the Mesa Verde Group and the Dakota Sandstone, can contribute high concentrations of iron, sulfate, and chloride to ground water. (Woodard-USGS)

Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado
Brogden, R. E.; Giles, T. F.
Geological Survey, Lakewood, CO. Water Resources Div.
Water-Resources Investigations 77-4 (open-file report), May 1977. 1 sheet, 2 tab, 7 ref.,
Journal Announcement: SWRA1103
Parts of the Yampa River basin near the towns of Steamboat Springs and Craig, Colo., have undergone rapid population growth in recent years. Fort Union, Lance, Williams Fork, and Iles Formations; and the Lewis and Mancos Shales. Well yields are generally less than 25 gpm (gallons per minute). In the alluvium of the Yampa River, well yields may be as much as 900 gpm. Where the sandstones of the Williams Fork and Iles Formations are fractured, well yields have been reported to be as much as 100 gpm. Well yields from the Lewis and Mancos Shales are less than 5 gpm. The quality of the ground water is variable and dependent on rock type. Most of the waters are calcium and sodium bicarbonate types. Calcium sulfate type waters are found where water in the aquifer has been in contact with gypsum, organic materials, or coals. Dissolved-solids concentrations of ground water range from as little as 82 to as much as 4,230 milligrams per liter. (Woodard-USGS)

Availability and Quality of Groundwater, Southern Ute Indian Reservation, Southwestern Colorado
Brogden, R. E.; Hutchinson, E. C.; Hillier, D. E.
Geological Survey, Lakewood, CO. Water Pesources Div.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $1.75. Geological Survey Water-Supply Paper 1576-J, 1979. 28 p, 4 Fig, 1 Plate, 5 Tab, 11 Ref.,
Journal Announcement: SWRA1407
Population growth and the potential development of subsurface mineral resources have increased the need for good quality groundwater on the Southern Ute Indian Reservation in southwestern Colorado. A study was conducted during 1974-76 to assess the groundwater resources of the Shale, Mesaverde Group, Lewis Shale, Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Shale, Animas and San Jose Formations, and terrace and flood-plain deposits. Well yields from sandstone and shale aquifers are Water quality in aquifers depends in part on rock type. Water from sandstone, terrace, and

flood-plain aquifers is predominantly a calcium bicarbonate type, whereas water from shale aquifers is predominantly a sodium bicarbonate type. Water from rocks containing interbeds of coal or carbonaceous shales may be either a calcium or sodium sulfate type. Dissolved-solids concentrations of groundwater range from 115 to 7,130 water from terrace and flood-plain aquifers is the least mineralized. In many water samples collected from bedrock, terrace, and flood-plain aquifers, the concentrations of arsenic, chloride, dissolved solids, fluoride, iron, manganese, nitrate, selenium, and sulfate exceeded U.S. Public Health Service (1962) recommended limits for drinking water. Selenium in the ground water in excess of the recommended limit of 10 micrograms per liter for drinking water occurs throughout the reservation but principally in the central part. (USGS)

GEOHYDROLOGY OF THE PICEANCE CREEK STRUCTURAL BASIN BETWEEN THE WHITE AND COLORADO RIVERS, NORTHWESTERN COLORADO

COFFIN, D. L.; WELDER, F. A.; GLANZMAN, R. K.

GEOLOGICAL SURVEY, WASHINGTON, D.C.

AVAILABLE FROM US GEOL SURVEY, WASHINGTON, D C 20242 - PRICE $1.25 PER SET. GEOLOGICAL SURVEY HYDROLOGIC INVESTIGATIONS ATLAS HA-370, 2 SHEETS, 1971. TEXT, 13 FIG, 5 MAP, 2 TAB, 8 REF.,

Journal Announcement: SWRAU508

THIS ATLAS DESCRIBES THE AVAILABILITY, OCCURRENCE AND CHEMICAL PROPERTIES OF THE WATER RESOURCES FOR PART OF THE PICEANCE CREEK STRUCTURAL BASIN IN NORTHWESTERN COLORADO. THE AREA IS BETWEEN THE WHITE AND COLORADO RIVERS, AN AREA OF ABOUT 1,600 SQUARE MILES IN PARTS OF RIO BLANCO, GARFIELD AND MESA COUNTIES. THE PICEANCE CREEK BASIN CONTAINS SOME OF THE RICHEST OIL SHALE DEPOSITS IN NORTH AMERICA. THESE DEPOSITS REPRESENT A HUGE POTENTIAL SOURCE OF PETROLEUM AND EFFORTS ARE CURRENTLY BEING MADE TO DEVELOP THE RESOURCE. SOME OF THE PROBLEMS ASSOCIATED WITH THE MINING AND RETORTING OF OIL SHALE ARE: REMOVAL OF WATER FROM MINES, SUPPLYING WATER FOR MINING AND RETORTING OPERATIONS, SUPPLYING ADDITIONAL DOMESTIC WATER FOR AN INCREASE IN POPULATION, EFFECT OF MINING OPERATIONS ON PRESENT USERS OF GROUNDWATER AND SURFACE WATER, AND WATER-QUALITY PROBLEMS CREATED BY MINING OPERATIONS. SURFACE-WATER SUPPLIES IN THE BASIN ARE SMALL AND ARE COMPLETELY DEVELOPED. PUMPING LARGE QUANTITIES OF GROUNDWATER FROM EITHER THE ALLUVIUM OR FROM THE LEACHED ZONE OF THE GREEN RIVER FORMATION WOULD HAVE ADVERSE EFFECTS ON PRESENT SURFACE SUPPLIES. (WOODARD-USGS)

MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE BOULDER-FORT COLLINS-GREELEY AREA, FRONT RANGE

URBAN CORRIDOR, COLORADO
COLTON, R. B.; FITCH, H. R.
GEOLOGICAL SURVEY, DENVER, COLO.
FOR SALE BY USGS, RESTON VA., 22092, PRICE $1.75. MISCELLANEOUS INVESTIGATIONS SERIES MAP I-855-D, 1974. 1 SHEET, 1 MAP, 1 TAB, 39 REF.,
Journal Announcement: SWRA0924

DEPOSITS OF HIGH-QUALITY GRAVEL IN THE BOULDER-FORT COLLINS-GREELEY, COLO., AREA MOSTLY UNDER FLOOD PLAINS AND TERRACES OF MAJOR STREAMS. GRAVEL AND ROCK RESOURCES HAVE BEEN GROUPED INTO FIVE MAP UNITS; TWO ARE SOURCES OF GRAVEL AND THREE ARE SOURCES OF ROCK SUITABLE FOR CRUSHING. THE MAP UNITS ARE BASED NOT ON QUALITY JUDGMENTS BUT ON DIFFERENCES IN PHYSICAL CHARACTERISTICS WHICH DO DETERMINE QUALITY WHICH, IN TURN, DETERMINES SUITABILITY FOR DIFFERENT USES. GRAVEL DEPOSITS, AS HERE DEFINED AND MAPPED, ARE INFERRED TO CONTAIN AT LEAST 20-PERCENT GRANULE-AND PEBBLE-SIZE STONES: SMALLER THAN 2.5 INCHES (6.5 CM) BUT RETAINED ON A NO. 10 (2 MM) U.S. STANDARD SIEVE. THE MINIMUM FIGURE OF 20 PERCENT IS ESTIMATED TO BE THE LOWER LIMIT AT WHICH GRAVEL CAN BE ECONOMICALLY EXTRACTED FROM A DEPOSIT. LOWER QUALITY DEPOSITS HAVE BEEN WORKED IN AREAS WHERE HAULAGE DISTANCES ARE SHORT AND A MARKET FOR SAND EXHISTS. (WOODARD-USGS)

Hydrologic and Climatologic Data, Southeastern Uinta Basin, Utah, and Colorado, Water Year 1978, (Duplicated see Utah).
Conroy, L. S.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $21.25 in paper copy, $5.50 in microfiche. Geological Survey Open-File Report 80-1025, 1980. 166 p, 6 Fig, 8 Tab, 2 Ref.,
Journal Announcement: SWRA1414

Climatologic and Hydrologic Data, Southeastern Uinta Basin, Utah and Colorado, Water Years 1975 and 1976, (Duplicated see Utah).
Conroy, L. S.; Fields, F. K.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Utah Basic-Data Release No. 29, 1977. 244 p, 5 fig, 10 tab.,
Journal Announcement: SWRA1117

HYDRAULIC TESTING AND SAMPLING OF USBM-AEC COLORADO CORE HOLE 3, RIO BLANCO COUNTY, COLORADO
CORDES, E. H.
GEOLOGICAL SURVEY, DENVER, COLO.
GEOLOGICAL SURVEY OPEN-FILE REPORT, DECEMBER 1969. 42 P, 12 FIG, 8 REF.,
Journal Announcement: SWRA0312

ON NOVEMBER 21, 1967, THE U. S. GEOLOGICAL SURVEY COMPLETED THE

HYDRAULIC TESTING AND SAMPLING OF USBM-AEC COLORADO CORE HOLE 3 IN RIO BLANCO COUNTY, COLORADO. THIS HOLE WAS DRILLED TO EXPLORE THE SITE FOR PROJECT BRONCO, A PLOWSHARE EXPERIMENT TO STUDY THE FEASIBILITY OF IN SITU RETORTING OF OIL SHALE AFTER BREAKING THE ROCK WITH A NUCLEAR EXPLOSION. THE HYDRAULIC TESTS INDICATE THE EXISTENCE OF A HIGHLY PERMEABLE WATER-BEARING ZONE IN THE UPPER AND MIDDLE PARTS OF THE PARACHUTE CREEK MEMBER OF THE GREEN RIVER FORMATION. THE ZONE YIELDED WATER IN EXCESS OF 2,700 CUBIC METERS PER DAY. NATURAL GROUNDWATER CIRCULATION DISSOLVED THE SALT DEPOSITS FROM A PART OF THE OIL SHALE, LEAVING A HIGHLY PERMEABLE ZONE. UNDERLYING ROCKS ARE COMPARATIVELY IMPERMEABLE, AND YIELDED LESS THAN 16 CUBIC METERS PER DAY OF HIGHLY SALINE FLUID. POTENTIAL FLOODING OF A RUBBLE CHIMNEY IS AN IMPORTANT CONSIDERATION FOR PROJECT FEASIBILITY AND SAFETY. A FIRST APPROXIMATION OF THE MAGNITUDE OF FLOODING WAS CALCULATED FROM THE TEST DATA. (KNAPP-USGS)

Quality of Ground Water in Routt County, Northwestern Colorado
Covay, K. J.; Tobin, R. L.
Geological Survey, Lakewood, CO. Water Resources Div.
Geological Survey Water Resources Investigations Open-File Report 80-956, 1981. 38 p, 8 Fig, 1 Plate, 6 Tab, 17 Ref.,
Journal Announcement: SWRA1511

Chemical and bacteriological data were collected to describe the quality of water from selected geologic units in Routt County, Colo. Calcium bicarbonate was the dominant water-chemistry type; magnesium, sodium, and sulfate frequently occurred as codominant ions. Specific conductance values ranged from 50 to 6,000 micromhos. Mean values of specific conductance, dissolved solids, and hardness from the sampled aquifers were generally greatest in waters from the older sedimentary rocks of the Lance Formation, Lewis Shale, Mesaverde Group, and Mancos Shale, and least in the ground waters from the alluvial deposits, Browns Park Formation, and the basement complex. Correlations of specific conductance with dissolved solids and specific conductance with hardness were found within specified concentration ranges. On the basis of water-quality analyses, water from the alluvial desposits, Browns Park Formation, and the basement complex generally is the most suitable for domestic uses. Chemical constituents in water from wells or springs exceeded State and Federal standards for public-water supplies or State criteria for agricultural uses were pH, arsenic, boron, chloride, iron, fluoride, manganese, nitrite plus nitrate, selenium, sulfate, or dissolved solids. Total-coliform bacteria were detected in water from 29 sites and fecal-coliform bacteria were detected in water from 6 of the 29 sites. (USGS)

UTILIZATION OF MULL (FOREST HUMUS LAYER) IN GEOCHEMICAL EXPLORATION IN THE EMPIRE DISTRICT, CLEAR CREEK COUNTY, COLORADO

CURTIN, G. C.; LAKIN, H. W.; HUBERT, A. E.; MOSIER, E. L.; WATTS, K. C.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
AVAILABLE FROM GPO, WASHINGTON, D.C. 20402 - PRICE $0.30 CENTS (PAPER COVER). GEOLOGICAL SURVEY BULLETIN 1278-B, 1971. 39 P, 25 FIG, 3 TAB, 18 REF.,
Journal Announcement: SWRA0508
RESULTS OF GEOCHEMICAL STUDIES IN THE EMPIRE DISTRICT, CLEAR CREEK COUNTY, COLO., SHOW THAT THE DISTRIBUTION OF ANOMALOUSLY HIGH AMOUNTS OF GOLD, COPPER, AND BISMUTH IN MULL (FOREST HUMUS LAYER) REFLECTS THE KNOWN DISTRIBUTION OF THESE METALS IN BEDROCK BENEATH AN EXTENSIVE COVER OF COLLUVIUM AND GLACIAL DRIFT; BUT THEIR DISTRIBUTION IN THE TRANSPORTED SOIL THAT UNDERLIES THE MULL POORLY DELINEATES THE DISTRIBUTION OF THE KNOWN METAL DEPOSITS. HIGH ANOMALIES OF SILVER, LEAD, ZINC, AND MOLYBDENUM IN THE MULL ENCIRCLE THE PRINCIPAL ANOMALIES OF GOLD, COPPER, AND BISMUTH AND MAY REFLECT ENRICHMENT OF SILVER, LEAD, ZINC, AND MOLYBDENUM IN THE BEDROCK BENEATH THE COLLUVIAL AND MORAINAL COVER. THE HIGH ANOMALOUS CONCENTRATIONS OF GOLD, COPPER, BISMUTH, SILVER, LEAD, ZINC, MOLYBDENUM, TIN, AND TUNGSTEN DETECTED IN THE MULL ASH AND THE DETECTION OF THESE METALS (EXCEPT TUNGSTEN) IN THE ASH OF PINE AND ASPEN TREES MAY REFLECT A GEOCHEMICAL CYCLE IN WHICH THESE METALS ARE LEACHED FROM THE BEDROCK, ARE ABSORBED BY THE TREES, AND THEN IN PART DEPOSITED IN THE LEAVES AND NEEDLES; THEY ARE FINALLY CONCENTRATED IN THE MULL AS THE LEAVES AND NEEDLES DECAY. SOME AREAS ANOMALOUSLY HIGH IN CERTAIN METALS IN MULL ARE NOT RELATED TO KNOWN MINERALIZATION AND MERIT FURTHER INVESTIGATION. (WOODARD-USGS)

Preliminary results of 1978 coal exploratory drilling in the Trinidad- Raton coal region, Las Animas County, Colorado
Danilchik, Walter, 1978
U.S. Geological Survey Open-File Report 78-1101, 19 p., 1 pl., 3 logs.

Geologic and coal outcrop map of the Madrid quadrangle, Las Animas County, Colorado
Danilchik, Walter, 1979a
U.S. Geological Survey Open-File Report 79-377, 1 pl., scale 1:24,000.

Geologic and coal outcrop map of the Weston quadrangle, Las Animas County, Colorado
Danilchik, Walter, 1979b
U.S. Geological Survey Open-File Report 79-927, 1 oversize sheet, scale 1:24,000.

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado
Ellis, S. R.; Mann, P. G.
Geological Survey, Lakewood, CO. Water Resources Div.
Geological Survey Open-File Report 81-1196 (WRI), 1981. 90 p, 11 Fig, 7 Plates, 8 Tab, 14 Ref.,
Journal Announcement: SWRA1512

Data were collected at the Hayden, Colo., powerplant for about a year during 1978-79 to monitor the effects of effluent and raw-water storage ponds on the local ground water, Sage Creek, and the Yampa River. The concentration of boron in wells downgradient from the effluent ponds indicated that the ponds were leaking, increasing the average boron concentrations in the ground water to a level in excess of the standards indicators of downgradient water quality, had average concentrations of boron two times that of the Colorado Department of Health (1977) standard for agricultural use of water. Chemical analyses of water from wells and the discharge weir downgradient from the raw-water storage ponds indicated these ponds are leaking. The effect of this leakage is that the water in wells downgradient from these ponds has a lower specific conductance and a lower boron concentration than the water in wells downgradient from the effluent ponds. The concentration of trace elements in the water from the wells and the discharge weir generally declined during the study, probably because the ground water was recovering from the effects of a plume from the raw-water pond previously used for fly-ash disposal. The effluents from the Hayden powerplant lowered the specific conductance and the iron and manganese concentrations, increased the concentration of boron, and had little or no effect on the selenium concentration in Sage Creek. Sage Creek had no discernible effect on the Yampa River because the volume of water in the Yampa River was so much greater. The effluents from the powerplant also had no discernible effect on the Yampa River. (USGS)

Preliminary report on the geology of the Coalmont district, Jackson County, Colorado
Erdmann, C. E., 1941
U.S. Geological Survey Open-File Report, 207 p., incl. appendix.

Reconnaissance of Groundwater in the Vicinity of Gunnison and Crested Butte, West-Central Colorado
Giles, T. F.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver,

CO 80225, Price: $7.00 in paper copy, $1.00 in microfiche. Geological Survey Open-File Report 80-12 (WRI), May, 1980. 23 Ref, 2 Sheets.,

Journal Announcement: SWRA1412

Hydrologic data was collected in the Gunnison-Crested Butte area, Colo., to determine the availability and chemical quality of groundwater. Parts of the area have undergone rapid population growth in recent years due to an increase of winter sports activities. This rapid growth has resulted in a demand for additional domestic, recreational, and municipal water supplies. Maximum yields of 100 gallons per minute are available from wells completed in the alluvial aquifers while as much as 60 gallons per minute may be obtained from wells completed in the Dakota and Entrada Sandstones. Yields from other aquifers generally are less than 25 gallons per minute. Calcium magnesium bicarbonate water is the predominant water type in the study area. Dissolved solids concentrations ranged from 30 to 829 milligrams per liter and hardness ranged from 18 to 400 milligrams per liter. (USGS)

Selected Hydrologic Data, Yampa River Basin and Parts of the White River Basin, Northwestern Colorado and South-Central Wyoming

Giles, T. F.; Brogden, R. E.

Geological Survey, Denver, CO. Water Resources Div.

Available from the OFSS Branch of Distribution, USGS, Box 25425 Fed. Ctr. Denver, Colo. 80225. Open-file report 78-23, January 1978. 91 p, 1 fig, 2 plates, 5 tab, 7 ref.,

Journal Announcement: SWRA1120

Selected hydrologic data are presented from four energy-related projects conducted by the U.S. Geological Survey in the Yampa River basin and parts of the White River basin in northwestern Colorado and south-central Wyoming. Water-quality data during 1974 and 1975 and parts of 1976 for 129 ground-water sites and 119 surface-water sites are tabulated. For most samples, major cations, anions, and trace metals were analyzed. For the same time period, field measurements of specific conductance, temperature, and pH were made on 252 springs and wells. These samplings sites, as well as the locations of 20 climatological stations, 18 snow-course sites, and 43 surface-water gaging stations, are shown on maps. Geologic units that contain coal deposits or supply much of the water used for stock and domestic purposes in the area also are shown on a map. (Woodard-USGS)

The Carboniferous formations and faunas of Colorado

Girty, G. H., 1903

U.S. Geological Survey Professional Paper 16, 546 p.

Availability and Quality of Ground Water in the Lake George Area, Southeastern Park County, Colorado

Goddard, K. E.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-291 899, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water Resources Investigations 78-50, July 1978. 28 p, 6 fig, 2 tab, 22 ref.,
Journal Announcement: SWRA1215

Water for domestic use in the Lake George area, Colo., is produced from four aquifers. Two of the aquifers, fractured-cyrstalline and volcanic rocks, have a water table ranging from 10 to 100 feet below land surface and well yields range from 0.08 to 6 gallons per minute. The consolidated sedimentary-rock and unconsolidated-alluvial aquifers have a water table ranging from near land surface to 60 feet below land surface and well yields range from 2 to 50 gallons per minute. The aquifers generally contain calcium bicarbonate water with concentrations of dissolved solids ranging from 101 to 636 milligrams per liter. In some areas, concentrations of iron as much as 18,000 micrograms per liter and concentrations of fluoride as much as 5.6 milligrams per liter affect suitability for domestic use. Chemical degradation of ground water has occurred in 18 of the 35 wells and in the 1 spring that were sampled. Bacterial contamination was found in water from six wells. (Woodard-USGS)

The Colorado Springs coal field, Colorado, in, Campbell, Morius R., geologist in charge, Contributions to economic geology, 1908, Part II- Mineral Fuels
Goldman, Marcus I., 1910
U.S. Geological Survey Bulletin 381, p.317-341.

Hexavalent Chromium in Ground and Surface Waters Near Telluride, Colorado -- A Preliminary Data Report --
Grove, D. B.; Miller, R. L.; Konikow, L. F.; O'Boyle, P. S.
Geological Survey, Denver, CO. Water Resources Div.
Geological Survey Open-File Report 79-700, 1979. 17 p, 2 Fig, 2 Tab, 5 Ref.,
Journal Announcement: SWRA1415

Data showing results of 38 groundwater and 25 surface-water samples analyzed for hexavalent chromium are presented. Most samples were taken within the Telluride, Colo., city limits during October 1978. Twenty-four of the 38 groundwater samples (63%) contained more than 50 micrograms per liter of hexavalent chromium. Excluding the mill tailings pond 6 of the 23 surface-water samples (26%) contained more than 50 micrograms per liter of hexavalent chromium. Hexavalent chromium concentrations in groundwaters ranged from 0 to 2700 micrograms per liter and in surface waters from 0 to 160 micrograms per liter. (USGS)

Hydrologic Data for wells, Springs, and Streams in Boulder County, Colorado
Hall, D. C.; Boyd, E. L.; Cain, D.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from: OFSS BX 25425, FED. CTR. Denver, CO printed copy $16.00 microfiche $4.00. Geological Survey open-file report 79-979, November 1979. 106 p, 7 Fig, 1 Plate, 5 Tab, 4 Ref.,
Journal Announcement: SWRA1311

Hydrologic data collected in 1975-77 as part of a comprehensive water-resources investigation of Boulder County, Colo., by the U.S. Geological Survey in cooperation with the Boulder County Health Department and the Colorado Geological Survey are presented in this report. The data, in tabular and graphic form, consist of water-quality analyses of selected constituents and geohydrologic-site, water-treatment, and sewage-treatment data for 609 wells and 48 springs; water-quality analyses for 102 of the wells and 9 of the springs; water-quality analyses of streamflow from 34 sites; and specific conductance and water-temperature measurements of streamflow from 3 sites. State and local officials in Boulder County may find these data useful in planning for residential, commercial, and industrial development. (Kosco-USGS)

Hydrologic Data from Upper Grange Hall Creek Basin, Northglenn, Adams County, Colorado
Hall, D. C.; Duncan, A. C.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, Co. 80225. Paper copy $17.75, microfiche $3.50. Geological Survey Open-File Report 80-578, 1980. 132 p, 2 Fig, 34 Tab, 10 Ref.,
Journal Announcement: SWRA1402

Hydrologic data collected during 1977-79 as part of a water-resources investigation of storm runoff in Upper Grange Hall Creek basin, Adams County, Colo., are presented in this report. Data presented in tabular form consist of: (1) Estimated daily precipitation at one site (April through October, 1978 and 1979); (2) mean daily streamflow at two sites (December 1977 through September 1979); (3) instantaneous streamflow at two sites along Grange Hall Creek and corresponding cumulative rainfall at one to three sites for 17 storms (April 1, 1978, to August 26, 1979); (4) concentrations of selected major ions, fecal-coliform bacteria, suspended sediment, nutrients, and trace elements at five sites during dry-weather flow, at three sites during rainfall runoff, and at five sites during snowmelt runoff; and (5) concentrations of pesticides and polychlorinated biphenyls at two sites during dry-weather flow and rainfall runoff. (USGS)

Water Resources of Boulder County, Colorado
Hall, D. C.; Hillier, D. E.; Cain, D.; Boyd, E. L.

Geological Survey, Denver, CO. Water Resources Div.

Available from the Colo. Geol. Survey, 1313 Sherman St., Denver, CO 80202, Price: $8.00 in paper copy. Colorado Department of Natural Resources Bulletin 42, 1980. 97 p, 19 Fig, 1 Plate, 23 Tab, 56 Ref.,

Journal Announcement: SWRA1407

Surface water is abundant in Boulder County, Colo., because large amounts of precipitation fall in the higher mountains and this precipitation feeds the streams directly or indirectly throughout the year. Ground water is an important source of water mostly for domestic, stock, or limited-acreage irrigation needs. The most frequently used aquifers are flood plain, terrace, Laramie-Fox Hills, Pierre-Niobrara-Benton, and crystalline rock. Median well yields of 15 or more gallons per minute occur for the flood plain, terrace, and Laramie-Fox Hills aquifers. The chemical and bacterial quality of the surface water is best at higher altitudes and decreases as the streams flow easterly to the plains and leave the county. The changes in water quality are influenced by the hydrogeology and the activities of man such as mining, farming, and sewage disposal. Many sources of water examined failed to meet Colorado Department of Health water-quality standards for raw drinking-water use, for agricultural use, and for aquatic life. Chemical quality of the ground water, particularly dissolved solids, is better in water from the unconsolidated- and crystalline-rock aquifers in the mountains and decreases in the aquifers on the plains. Factors involved in the decrease of quality are the geohydrology and the quality of associated surface water. Local contamination of ground water by subsurface wastewater disposal is a frequent problem. (USGS)

MAP SHOWING AVAILABILITY OF HYDROLOGIC DATA PUBLISHED BY THE U. S. ENVIRONMENTAL DATA SERVICE, AND BY THE U.S. GEOLOGICAL SURVEY AND COOPERATING AGENCIES, GREATER DENVER AREA, FRONT RANGE URBAN CORRIDOR, COLORADO

HAMPTON, E. R.

GEOLOGICAL SURVEY, DENVER, COLO.

FOR SALE BY USGS, RESTON, VA, 22092, $1.25. MISCELLANEOUS INVESTIGATIONS SERIES MAP I-856-C, 1975. 1 SHEET, 1 MAP, 41 REF.,

Journal Announcement: SWRAU924

THIS MAP SHOWS TYPES AND LOCATIONS OF THE HYDROLOGIC DATA PUBLISHED AS OF JANUARY 1974 FOR THE GREATER DENVER AREA BY THE U.S. ENVIRONMENTAL DATA SERVICE AND BY THE U.S. GEOLOGICAL SURVEY AND COOPERATING AGENCIES. THE SOURCES OF THE DATA ARE GIVEN IN BOTH THE DISCUSSION AND THE REFERENCE. CLIMATOLOGICAL DATA INCLUDE RECORDS OF PRECIPITATION, TEMPERATURE, AND EVAPORATION. SURFACE-WATER DATA INCLUDE CONTINUOUS RECORD OF STAGE AND DISCHARGE OF STREAMS; CREST-STAGE AND LOW-FLOW DISCHARGE OF STREAMS; CHEMICAL QUALITY OF STREAMS, LAKES, AND RESERVOIRS; SEDIMENT LOAD OF STREAMS; AND STAGE OF RESERVOIRS. LOCATIONS OF 46 SURFACE-WATER

DATA SITES ARE SHOWN ON THE MAP. GROUND-WATER DATA SITES PLOTTED ON THE MAP REPRESENT 218 WELLS WHERE WATER LEVELS HAVE BEEN MEASURED PERIODICALLY FOR 4 OR MORE YEARS OR MONTHLY FOR AT LEAST 1 YEAR, AND 366 WELLS FROM WHICH WATER SAMPLES HAVE BEEN ANALYZED FOR DISSOLVED-CHEMICAL CONSTITUENTS. (WOODARD-USGS)

Coal resources of Trinidad-Aquilar area, Las Animas and Huerfano Counties, Colorado.
Harbour, R. L., and Dixon, G. H., 1959
U.S. Geological Survey Bulletin 1072-G, p. iv, 445-489.

General geology and petrology of the Pre-cambrium crystalline rocks, Park and Jefferson Counties, Colorado
Hawley, C. C., and Wobus, R. A., 1977
U.S. Geological Survey Professional Paper 608-B, p. B1-B77.

Mining in Colorado - A history of discovery, development, and production, by C. W. Henderson
Henderson, C. W., 1926
U.S. Geological Survey Professional Paper 138, 263 p.

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1979
Hillier, D. E.
Geological Survey, Lakewood, CO. Water Resources Div.
Geological Survey open-file report 79-402, March 1979. 101 p, 33 fig, 1 plate, 1 tab.,
Journal Announcement: SWRA1217
Water-resources data-collection activities for October 1, 1978, through September 30, 1979, are summarized for Colorado and bordering States. Forty-nine interpretive hydrologic investigations include: 6 statewide investigations, 5 regional investigations, 10 investigations in the Missouri River basin, 8 investigations in the Arkansas River basin, 3 investigations in the Rio Grande basin, 15 investigations in the Colorado River basin, and 2 multistate investigations. The summaries of the investigations consist of maps showing the location of the areas of investigations and a brief description of the investigation's purpose, objective, approach, progress, and plans. (Woodard-USGS)

Well Yields and Chemical Quality of Water From Water-Table Aquifers in the Colorado Springs--Castle Rock Area, Front Range Urban Corridor, Colorado
Hillier, D. E.; Hutchinson, E. C.
Geological Survey, Lakewood, CO. Water Resources Div.

Branch of Distribution, USGS, Box 25286, Fed. Ctr., Denver, CO 80225, $3.00 in paper copy. Geological Survey Miscellaneous Investigations Series Map I-857-I, 1980. 2 Sheets, 12 Ref.,

Journal Announcement: SWRA1321

Industrial, irrigation, and public-supply wells completed in unconsolidated alluvial deposits and the Dawson aquifer, the principal water-table aquifers in the area, have measured and reported yields ranging from less than 100 to 1,000 gallons per minute. Most wells yielding more than 500 gallons per minute are located in the Colorado Springs area and are completed in unconsolidated alluvial deposits. The maximum reported yields from the Dawson aquifer are 500 gallons per minute. Most of the principal water-table aquifers yield water containing dissolved solids concentrations less than 500 milligrams per liter. Water containing more than 500 milligrams per liter of dissolved solids occurs principally in the Colorado Springs area. Water containing less than 500 milligrams per liter of dissolved solids generally is suitable for all uses associated with urban development. The potential uses for urban development decrease as dissolved solids concentrations in the water increase. (USGS).

Well Yields and Chemical Quality of Water From Water-Table Aquifers in the Colorado Springs--Castle Rock Area, Front Range Urban Corridor, Colorado

Hillier, D. E.; Hutchinson, E. C.

Geological Survey, Lakewood, CO. Water Resources Div.

Branch of Distribution, USGS, Box 25286, Fed. Ctr., Denver, CO 80225, $3.00 in paper copy. Geological Survey Miscellaneous Investigations Series Map I-857-I, 1980. 2 Sheets, 12 Ref.,

Journal Announcement: SWRA1321

Industrial, irrigation, and public-supply wells completed in unconsolidated alluvial deposits and the Dawson aquifer, the principal water-table aquifers in the area, have measured and reported yields ranging from less than 100 to 1,000 gallons per minute. Most wells yielding more than 500 gallons per minute are located in the Colorado Springs area and are completed in unconsolidated alluvial deposits. The maximum reported yields from the Dawson aquifer are 500 gallons per minute. Most of the principal water-table aquifers yield water containing dissolved solids concentrations less than 500 milligrams per liter. Water containing more than 500 milligrams per liter of dissolved solids occurs principally in the Colorado Springs area. Water containing less than 500 milligrams per liter of dissolved solids generally is suitable for all uses associated with urban development. The potential uses for urban development decrease as dissolved solids concentrations in the water increase. (USGS).

Hydrologic Data for Water-Table Aquifers in the Greater Denver Area, Front Range Urban Corridor, Colorado

Hillier, D. E.; Schneider, P. A. Jr; Hutchinson, E. C.

Geological Survey, Lakewood, CO. Water Resources Div.
Availability: OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225. Price: Paper copy, $14.25, Microfiche, $4.25. Geological Survey open-file report 79-214, January 1979. 68 p, 2 fig, 1 plate, 4 tab, 5 ref.,
Journal Announcement: SWRA1217

As part of the U.S. Geological Survey's investigations of the hydrology and geology in the Front Range Urban Corridor of Colorado, hydrologic data for water-table aquifers in the greater Denver area were collected and compiled during 1976-77. These data, consisting of records for 325 wells and 11 springs and chemical analyses of water for 272 of the wells and all 11 springs, are presented in tabular form. The tables contain data that were collected during the investigation, data compiled from reports published by the Colorado Water Conservation Board and the U.S. Geological Survey, and unpublished data from the files of the U.S. Geological Survey. State and local officials in the greater Denver area may find these data useful in planning for residential, commercial, and industrial development. (Woodard-USGS)

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1977
Hillier, D. E.; Weeks, J. B.
Geological Survey, Lakewood, CO. Water Resources Div.
Open-file report 77-532, June 1977. 88 p, 30 fig, 1 plate, 1 tab.,
Journal Announcement: SWRA1105

Current water-resources data-collection activities in Colorado are summarized for the 1977 fiscal year. The locations of long-term data-collection stations are shown on a map of the State. Forty-three interpretive hydrologic investigations are summarized: 6 statewide investigations, 6 regional investigations, 11 investigations in the Missouri River basin, 5 investigations in the Arkansas River basin, 2 investigations in the Rio Grande basin, and 13 investigations in the Colorado River basin. The summaries of the investigations consist of a map showing the location of the area of the investigation and a brief description of the investigation's purpose, objective, approach, progress, and plans. (Woodard-USGS)

Residuals Management: A Tool in River-Quality Assessment Applied to Coal Development in the Yampa River Basin, Colorado
Hirsch, R. M.; James, I. C. II; Schefter, J. E.
Geological Survey, Reston, VA.
In: River-Quality Assessments; Proceedings of a Symposium held in Tucson, Arizona, November 2-3, 1977. p 142-164, 1978. 3 Fig, 7 Tab, 17 Ref, 1 Append.,
Journal Announcement: SWRA1311

Residuals management provides a basis for projecting the effects of economic development on the discharge of residuals to the environment and on the use of water. It is a useful technique of river-quality assessment for basins wherein substantial economic growth is either occurring or expected. Residuals management techniques were utilized to assess the effects of coal development and utilization in the Colorado part of the Yampa River basin. Plant-level models were used to describe the material and energy balances and the operating costs of surface mining of coal, the Synthane process of coal gasification, coal-fired thermal-electric generation of power transportation of coal by coal-slurry pipeline, and transportation by unit train. As part of the model of electric power generation, four alternative methods of cooling are considered: once-through cooling, cooling ponds, wet cooling towers, and dry cooling towers. Each of these models provides estimates of water withdrawal, water consumption, and residuals generated directly by the particular process the total growth of the regional economy under four coal-development scenarios. The amount of coal assumed to be mined is constant across all of these, but each of them assumes a different use of the 'new' coal: gasification, electric power generation, coal-slurry pipeline export, or model to provide estimates of total (direct and indirect) water use and residuals generation in the regional economy under the four scenarios. (See also W80-03606) (Humphreys-ISWS)

Descriptors: *River basins ; *Colorado ; *Long-term planning ; *Model studies ; *Regional analysis ; *Yampa River Basin(CO); Planning ; Water utilization ; Coals ; Costs ; Economics ; Industrial plants ; Consumptive use ; Management ; Thermal powerplants ; Resources development ; Coal development ; Plant-level models ; Regional models ; Coal gasification ; Electric power generation

Section Heading Codes: 6B .(Water Resources Planning--Evaluation Process) ; 6D .(Water Resources Planning--Water Demand)

Results of Test Drilling for Groundwater in the Southeastern Uinta Basin, Utah and Colorado, (Duplicated see Utah).
Holmes, W. F.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Geological Survey Water-Resources Investigations 80-951. 1980. 90 p, 15 Fig, 6 Plates, 13 Tab, 5 Ref.,
Journal Announcement: SWRA1419

Water Resources of the Northern Uinta Basin Area, Utah and Colorado, with Special Emphasis on Ground-Water Supply
Hood, J. W.; Fields, F. K.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Utah Department of Natural Resources Technical Publication No. 62, 1978. 75 p, 20 fig, 5 plates, 9 tab, 44 ref.,
Journal Announcement: SWRA1217

During 1971-74, hydrologic studies were made in a 5,200 square-mile area of the Unita Basin and Uinta Mountains. The principal sources of water are precipitation and trans-basin inflow through the Green and White Rivers, which for the period 1941-70 annually averaged 4.87 million acre-feet and 3.55 million acre-feet, respectively. Of the water from precipitation within the area, 190,000 acre-feet was exported annually and 440,000 acre-feet entered the Green River. The ground-water system is in unconsolidated and consolidated rocks. Gross recharge is estimated to be 500,000 acre-feet, of which 200,000 acre-feet returns to streams in the water in storage significantly. Fresh to slightly saline water in storage amounts to an estimated 28 million acre-feet. Approximately 160,000 acre-feet is consumed by evapotranspiration, 12,000 acre-feet is consumed by man, and 128,000 acre-feet is discharged to streams. During high flow, all streams are fresh; during low flow, water at the mouths of some tributaries is slightly to moderately saline. Ground water ranges from fresh to briny. Fresh to slightly saline water can be obtained from at least one aquifer in about two-thirds of the area. (Woodard-USGS)

Selected Hydrologic Data, Uinta Basin Area, Utah and Colorado
Hood, J. W.; Mundorff, J. C.; Price, D.
Geological Survey, Salt Lake City, Utah. Water Resources Div.
Utah Basic-Data Release No 26, Salt Lake City, 1976. 321 p, 9 fig, 2 plates, 15 tab, 19 ref.,
Journal Announcement: SWRA1017

The Uinta Basin area in northeastern Utah and northwestern Colorado covers an area of slightly more than 10,000 sq mi. More than 95 percent of the basin is in Utah, thus most of the data in this report apply to Utah. Selected data are consolidated from available records of water wells, springs, petroleum-test wells, and streams. Included are well logs, laboratory analyses of grain-size distribution and hydrologic properties of aquifer samples, water levels in observation wells, stream discharge, and water-quality records for all types of water sources. (Woodard-USGS)

Ground-Water Resources of the Alluvial Aquifers in Northeastern Larimer County, Colorado
Hurr, R. T.; Schneider, P. A. Jr
Geological Survey, Lakewood, CO. Water Resources Div.
Water-Resources Investigations 77-7 (open-file report), January 1977. 31 p, 5 fig, 6 plates, 7 tab, 13 ref.,
Journal Announcement: SWRA1102

Ground water is a source of municipal, domestic, stock, and irrigation supply for most of northeastern Larimer County, Colo. A study of the alluvial aquifers in the northeastern part of the county was conducted to determine volume of water in storage, rate and location of ground-water withdrawals, and chemical quality of the water with particular attention to dissolved solids, hardness, sulfate, and selenium.

There are 251 large-capacity wells in the study area. Well yields range from about 80 gpm (gallons per minute) to a little over 1,800 gpm. Total volume of water in storage is about 133,000 acre-feet--32,000 acre-feet in the alluvium of Buckeye terrace and 101,300 acre-feet in the valley-fill aquifer associated with Boxelder Creek. Ground-water withdrawals for irrigation are about 25,000 acre-feet annually. The municipal wells pumped 210 acre-feet in 1974. The factors affecting ground-water quality are the quality of applied irrigation water, the amount of water lost to evapotranspiration during irrigation, and, to a lesser degree, solution of soluble material in the alluvium and in the bedrock at the base of the alluvium. Ground water at dissolved solids. Recharge is from surface water containing less than 90 downgradient to the south due to solution and evaporative concentration. (Woodard-USGS)

Water-Quality Data for the Southern Ute Indian Reservation, Southwestern Colorado
Hutchinson, E. C.; Brogden, R. E.
Geological Survey, Lakewood, Colo. Water Resources Div.
Open-file report 76-16, December 1976. 36 p, 2 fig, 2 plates, 2 tab, 7 ref.,
Journal Announcement: SWRA1021

Water-quality data from a study by the U.S. Geological Survey on the Southern Ute Indian Reservation in southwestern Colorado are presented in two tables. The data were collected during 1973-76 from 338 ground-water and surface-water samples. All samples were analyzed for major catons and anions, and selenium and arsenic. Data in the tables are keyed by numbers to maps showing the locations of sampling sites. Many of the samples contained arsenic, chloride, dissolved solids, fluoride, iron, magnesium, manganese, nitrate, nitrite-plus-nitrate as nitrogen, selenium, and sulfate in concentrations exceeding recommended or mandatory standards for drinking water established by the Colorado Department of Health and U.S. Public Health Service. (Woodard-USGS)

Hydrologic Data for Water-Table Aquifers in the Colorado Springs--Castle Rock Area, Front Range Urban Corridor, Colorado
Hutchinson, E. C.; Hillier, D. E.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. microfiche $4.00, paper copy $10.00. Geological Survey open-file report 78-948, December 1978. 41 p, 2 fig, 1 plate, 4 tab, 3 ref.,
Journal Announcement: SWRA1215

As part of the U.S. Geological Survey's investigations of the hydrology and geology in the Front Range Urban Corridor of Colorado, hydrologic data for water-table aquifers in the Colorado Springs--Castle Rock area were collected and compiled during 1976-77. These data, consisting of records for 157 wells and 47 springs and chemical analyses of water for 135 of the wells and all 47 springs, are presented in tabular form. The tables contain data that were collected during the investigation, data compiled from reports published by the Colorado Water Conservation Board, and unpublished data from the files of the U.S. Geological Survey. State and local officials in the Colorado Springs--Castle Rock area may find these data useful in planning for residential, commercials, and industrial development. (Woodard-USGS)

Hydrologic studies of the U.S. Geological Survey related to coal development in Colorado
U.S. Geological Survey Open-File Report 76-549, August 1976, 22 p., 5 Fig.

A review of selected laws and governmental programs in Colorado as related to mineral resource management and surface mining
Imhoff, E. A., 1976
U.S. Geological Survey Open-File Report 76-649.

Geology and coal resources of the Walsenburg area, Huerfano County, Colorado
Johnson, R. B., 1958
U.S. Geological Survey Bulletin 1042-O, 557-583.

Geology of the igneous rocks of the Spanish Peaks region, Colorado
Johnson, R. B., 1968
U.S. Geological Survey Professional Paper 594-G, p. G1-G47.

Coal resources of the La Veta area, Huerfano County, Colorado
Johnson, R. B., and Stephens, J. G., 1954
U.S. Geological Survey Coal Investigations Map C-20, scale 1:31,360.

RECONNAISSANCE INVESTIGATION OF GROUND WATER IN THE RIO GRANDE DRAINAGE BASIN--WITH SPECIAL EMPHASIS ON SALINE GROUND-WATER RESOURCES
KELLY, T. E.
GEOLOGICAL SURVEY, RESTON, VA.
FOR SALE BY USGS, 1200 S. EADS ST., ARLINGTON, VA, 22202 PRICE $1.50 PER SET. HYDROLOGIC INVESTIGATIONS ATLAS HA-510, 1974. 4

SHEETS, 14 MAPS, 47 REF.,

Journal Announcement: SWRA0805

THE SURFACE-WATER RESOURCES OF THE RIO GRANDE DRAINAGE BASIN, COLORADO, NEW MEXICO, AND TEXAS, ARE INSUFFICIENT TO MEET PRESENT NEEDS IN MOST OF THE BASIN. GROUNDWATER SUPPLIES HAVE BEEN EXTENSIVELY DEVELOPED FOR IRRIGATION AND FOR MUNICIPALITIES. IN AREAS OF HEAVY GROUNDWATER USE, WITHDRAWALS OFTEN SUBSTANTIALLY EXCEED ANNUAL RECHARGE; THEREFORE THE GROUNDWATER IN STORAGE IS BEING DEPLETED STEADILY, WITH ACCOMPANYING DETERIORATION IN QUALITY. GROUNDWATER IN THE RIO GRANDE BASIN CAN BE DIVIDED INTO TWO MAJOR QUALITY TYPES: FRESHWATER WHICH GENERALLY IS NEAR THE SURFACE, AND THE MORE DEEPLY BURIED SALINE WATER. FRESHWATER IS PRESENT IN SIGNIFICANT QUANTITIES IN MOST OF THE RIO GRANDE BASIN IN COLORADO AND NEW MEXICO, AND IN PARTS OF WEST TEXAS. THE GREATEST THICKNESS OF THE FRESHWATER AQUIFER IS PRESENT IN THE SAN LUIS STRUCTURAL BASIN OF COLORADO. THROUGHOUT THIS ENTIRE BASIN THE WATER TABLE GENERALLY IS LESS THAN 12 FEET BELOW THE LAND SURFACE. THE MIDDLE BASIN AREA IS CHARACTERIZED BY WELL LITHIFIED PALEOZOIC ROCKS. LIMESTONE IS THE MAJOR LITHOLOGY. THROUGHOUT MOST OF THIS AREA FRESHWATER IS PRESENT IN THE THIN ALLUVIAL DEPOSITS OF THE RIVER VALLEYS; IN OTHER AQUIFERS THE WATER RANGES IN QUALITY FROM SLIGHTLY SALINE TO BRINE. THE LOWER BASIN REGION IS SIMILAR TO THE MIDDLE BASINS, BUT THE ROCKS GENERALLY ARE MESOZOIC IN AGE AND THE GROUNDWATER IS LESS HIGHLY MINERALIZED. THE MAJOR AQUIFERS IN THE REGION ARE LIMESTONE AND MARL OF CRETACEOUS AGE WHICH GENERALLY YIELD FRESHWATER TO WELLS AT SHALLOW (KNAPP-USGS)

A discussion of legal and institutional constraints on energy-related water development in the Yampa River basin, northwestern Colorado

Knudsen, W. I., Jr., and Danielson, J. A., 1977

U.S. Geological Survey Contract Completion Report No. 14-08-0001-15075, 20 p.

Statistical Summaries of Water-Quality Data for Two Coal Areas of Jackson County, Colorado

Kuhn, G.

Geological Survey, Lakewood, CO. Water Resources Div.

Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225, Price: $3.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-121, 1982. 23 p, 3 Fig, 9 Tab, 13 Ref.,

Journal Announcement: SWRA1602

Statistical summaries of water-quality data are compiled for eight streams in two separate coal areas of Jackson County, Colo. The quality-of-water data were collected from October 1976 to September 1980. For inorganic constituents, the maximum, minimum, and mean concentrations, as well as other statistics are presented; for minor elements, only the maximum, minimum, and mean values are included. Least-squares equations (regressions) are also given relating specific conductance of the streams to the concentration of the major ions. The observed range of specific conductance was 85 to 1,150 micromhos per centimeter for the eight sites. (USGS)

Coal resources of Colorado; tabulated by bed;
Landis, E. R., and Cone, G. C., 1971
U.S. Geological Survey Open-File Report, 525 p. of tables, explanation; (basic survey data is used in compilation of U.S. Geological Survey Bulletin 1072-C, 1959).

Coal resources of Colorado
Landis, E. R., 1959
U.S. Geological Survey Bulletin 1072-C, p. 131-232.

CHEMICAL AND RADIOCHEMICAL ANALYSES OF WATER FROM STREAMS, RESERVOIRS, WELLS, AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO
LARSON, J. D.; BEETEM, W. A.
GEOLOGICAL SURVEY, DENVER, COLO.
GEOLOGICAL SURVEY OPEN-FILE REPORT, JAN 1970. 16 P, 2 FIG, 6 TAB, 6 REF. CONTRACT NO AT(29-2)-474 USAEC.,
Journal Announcement: SWRA0311
WELLS WERE INVENTORIED AND SAMPLED, AND A NETWORK OF 21 SURFACE-WATER SAMPLING STATIONS WAS ESTABLISHED IN THE RULISON AREA, COLORADO, TO DETERMINE CHANGES IN TRITIUM CONTENT AND WATER CHEMISTRY ATTRIBUTABLE TO THE RULISON PROJECT, AN EXPERIMENT IN STIMULATING NATURAL GAS PRODUCTION BY A NUCLEAR EXPLOSION. LOCATIONS OF THE SAMPLING SITES, PRE-EXPLOSION CHEMICAL ANALYSES OF SURFACE WATERS AND GROUNDWATERS, WELL RECORDS, CISTERN RECORDS, AND SPRING RECORDS ARE TABULATED. (KNAPP-USGS)

APPRAISAL OF WATER RESOURCES OF NORTHWESTERN EL PASO COUNTY, COLORADO
LIVINGSTON, R. K.; BINGHAM, D. L.; KLEIN, J. M.
GEOLOGICAL SURVEY, DENVER, COLO.
COLORADO WATER CONSERVATION BOARD, DENVER, WATER RESOURCES CIRCULAR NO 22, 1975. 75 P, 33 FIG, 3 PLATES, 14 TAB, 36 REF.,
Journal Announcement: SWRA0918

AN APPRAISAL OF THE WATER RESOURCES OF NORTHWESTEN EL PASO COUNTY, COLO., WAS MADE AS THE FIRST PART OF A 3-YEAR STUDY OF THE ENTIRE COUNTY. MEAN ANNUAL PRECIPITATION RANGES FROM 14 TO 30 IN. AND IS A FUNCTION OF ALTITUDE. THE AREA IS DRAINED BY FOUNTAIN CREEK AND ITS TRIBUTARIES WHICH HAVE BEEN DESCRIBED BY MEANS OF THE OBSERVED FLOW CHARACTERISTICS AT 27 STREAM-GAGING SITES AND THE ESTIMATED FLOW CHARACTERISTICS AT 14 SITES. A WATER BUDGET SHOWS THE AVERAGE ANNUAL WATER INVENTORY IS ABOUT 520,000 ACRE-FT, OF WHICH ABOUT 92 PERCENT IS EVAPOTRANSPIRED. AN INVENTORY OF LAKES AND RESERVOIRS INDICATES THE STORAGE CAPACITY OF ONE RESERVOIR, NORTHFIELD RESERVOIR NO. 5, IS OVER ONE-HALF OF THE AREA'S TOTAL SURFACE-WATER STORAGE CAPACITY. THE ANNUAL PRECIPITATION AT COLORADO SPRINGS, THE COUNTRY'S LARGEST MUNICIPALITY, RANGED BETWEEN 8 AND 25 IN. IN THE LAST 24 YEARS. COLORADO SPRINGS OBTAINS ABOUT 89 PERCENT OF ITS TOTAL DOMESTIC WATER SUPPLY FROM SURFACE-WATER SOURCES. THE WATER SUPPLY FOR COLORADO SPRINGS APPEARS ADEQUATE UNTIL 1990 DUE TO THE REUSE AND TRANSMOUNTAIN IMPORTATION OF WATER. WATERS FROM STREAMS DRAINING PIKES PEAK ARE OF GOOD QUALITY FOR DOMESTIC USE EXCEPT FOR CONCENTRATIONS OF FLUORIDE WHICH EXCEED LIMITS OF DRINKING-WATER STANDARDS. DOWNSTREAM FROM COLORADO SPRINGS THE WATER IN FOUNTAIN CREEK IS BADLY POLLUTED DUE TO SEWAGE. THE PRINCIPAL AQUIFERS ARE ALLUVIAL DEPOSITS AND THE DAWSON FORMATION. CALCULATED RECHARGE RATES RANGE FROM 0 TO 4 IN. PER YEAR. IN THE PRINCIPAL AREAS OF RECHARGE TO THE DAWSON, THE DISSOLVED-SOLIDS CONCENTRATION OF IN AREAS OF DISCHARGE. (WOODARD-USGS)

Water Resources of El Paso County, Colorado
Livingston, R. K.; Klein, J. M.; Bingham, D. L.
Geological Survey, Lakewood, Colo. Water Resources Div.
Colorado Water Conservation Board, Denver, Colorado Water Resources Circular No 32, 1976. 85 p, 53 fig, 4 tab, 7 append.,
Journal Announcement: SWRA1008

The rate of population growth in El Paso County, Colo., has been one of the fastest in the United States. Continued rapid population growth has been accompanied by a similar growth in demand for industrial and municipal water. The largest municipality in the county, Colorado Springs, imports more than one-half of its water from sources outside the county. Estimated water budgets for four drainage indicate that precipitation and evapotranspiration account for 82 to 100 percent of the water entering and leaving each basin. The county is drained by tributaries of both the South Platte and Arkansas

Rivers--the Arkansas River basin draining about 95 percent of the county. The dissolved-solids concentration of water in the streams of the county is inversely related to streamflow. The addition of sewage effluent deteriorates the water quality of Fountain Creek. The principal alluvial aquifers are in Fountain Creek and Jimmy Camp Creek valleys, which contain an estimated 100,000 acre-feet of water in storage, and in the upper Black Squirrel Creek basin, which contains an estimated 350,000 acre-feet of water in storage. The dissolved-solids concentration The principal bedrock aquifer, the Dawson Formation contains an estimated 38 million acre-feet of water in the upper 500 feet of saturated thickness. In most areas the dissolved-solids concentration of ground water from the Paso County can be augmented primarily by future increased water imports from outside of the county and reuse of that water, and by increased use of ground water. (Woodard-USGS)

Ground Water in the San Juan Basin, New Mexico and Colorado
Lyford, F. P.
Geological Survey, Albuquerque, NM. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-108020, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-73, May 1979. 22 p, 11 Fig, 27 Ref.,
Journal Announcement: SWRA1311

Principal aquifers in the San Juan Basin of New Mexico and Colorado are the Entrada Sandstone, Westwater Canyon Member of the Morrison Formation, Gallup Sandstone of the Mesaverde Group, several sandstones in the Mesaverde Group above the Gallup (Dalton Sandstone Member of the Crevasse Canyon Formation, Point Lookout Sandstone, Menefee Formation, Cliff House Sandstone), and sandstones of Tertiary age. Most ground water flows from topographically high outcrop areas toward the San Juan River and Rio Grande valley. Much of the water may move through confining layers to other aquifers or to the land surface rather than discharging directly to the streams. Transmissivities of the sandstones range from 50 to 300 square feet per day. Lowest dissolved-solids concentrations occur in or near outcrops of the sandstones and increase in the direction of groundwater flow. Concentrations range from less than 500 milligrams per liter to more than 30,000 milligrams per liter. (Kosco-USGS)

MAP SHOWING APPROXIMATE GROUNDWATER CONDITIONS IN THE PARKER QUADRANGLE, ARAPAHOE AND DOUGLAS COUNTIES, COLORADO
MABERRY, J. O.; HAMPTON, E. R.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
FOR SALE BY USGS, WASHINGTON, D.C. 20242, PRICE - $0.75. GEOLOGICAL SURVEY MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAPS, MAP I-770-K, 1972. 1 MAP, 3 REF.,

Journal Announcement: SWRA0613

A MAP (SCALE 1:24,000) OF THE PARKER QUADRANGLE, ARAPAHOE AND DOUGLAS COUNTIES, COLORADO, SHOWS APPROXIMATE GROUNDWATER CONDITIONS. GROUNDWATER IS OBTAINED PRINCIPALLY FROM THREE AQUIFER SYSTEMS: STREAM ALLUVIUM AND ALLUVIAL TERRACES, RELATIVELY SHALLOW BEDROCK, AND RELATIVELY DEEP BEDROCK UNITS. THE GREATEST AMOUNTS OF READILY AVAILABLE GROUNDWATER OCCUR IN THE SAND AND GRAVEL ALLUVIAL FILL OF CHERRY CREEK VALLEY AND UPLAND ALLUVIAL AND TERRACE DEPOSITS OF ITS MAJOR DISTRIBUTARIES. THE ALLUVIUM IS AS MUCH AS 150 FEET THICK IN CHERRY CREEK VALLEY. LARGE-CAPACITY WELLS PRODUCING FROM ALLUVIUM ALONG CHERRY CREEK YIELD FROM 900 TO 1,800 GPM AND AVERAGE ABOUT 1,200 GPM. MOST OF THESE WELLS ARE USED FOR MUNICIPAL WATER SUPPLIES. DISSOLVED SOLIDS IN WATER FROM THE ALLUVIUM RANGE FROM 280 TO 380 PPM. (WOODARD-USGS)

MAP SHOWING FLOOD-PRONE AREAS, COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO
MCCAIN, J. F.; HOTCHKISS, W. R.
GEOLOGICAL SURVEY, DENVER, COLO.
FOR SALE BY USGS, RESTON, VA 22090, PRICE $0.75. MISCELLANEOUS INVESTIGATIONS SERIES MAP I-857-C, 1975. 1 SHEET, 1 MAP, 9 REF.,
Journal Announcement: SWRA0902

THE RAPID GROWTH OF POPULATION IN THE FRONT RANGE URBAN CORRIDOR OF COLORADO IS CAUSING INTENSE COMPETITION FOR AVAILABLE LAND RESOURCES. ONE FORM OF COMPETITION POSING SERIOUS PROBLEMS IS UNREGULATED DEVELOPMENT ALONG NATURAL WATERCOURSES. THIS MAP DEPICTS A BROAD-SCALE VIEW OF FLOOD-PRONE AREAS ALONG PRINCIPAL STREAMS IN THE COLORADO SPRINGS-CASTLE ROCK AREA OF THE URBAN CORRIDOR. FLOOD-PRONE AREAS IDENTIFIED ARE SUBJECT TO INUNDATION BY THE 100-YEAR FLOOD, A FLOOD HAVING A 1 PERCENT CHANGE OF BEING EQUALED OR EXCEEDED ANY GIVEN YEAR. THE MAGNITUDE AND DEPTH OF THE REFERENCE FLOOD WERE DERIVED FOR STREAMS IN THE STUDY AREA FROM STREAMFLOW RECORDS AND REPORTS OF THE U.S. GEOLOGICAL SURVEY AND FROM REPORTS OF THE U. S. ARMY CORPS OF ENGINEERS. (WOODARD-USGS)

MAP SHOWING FLOOD-PRONE AREAS, GREATER DENVER AREA, FRONT RANGE URBAN CORRIDOR, COLORADO
MCCAIN, J. F.; HOTCHKISS, W. R.
GEOLOGICAL SURVEY, DENVER, COLO.
FOR SALE USGS, RESTON, VA 22092, PRICE $0.75. MISCELLANEOUS INVESTIGATIONS SERIES MAP I-856-D, 1975. 1 SHEET, 1 MAP, 21 REF.,
Journal Announcement: SWRA0903

THE RAPID GROWTH OF POPULATION IN THE FRONT RANGE URBAN CORRIDOR OF COLORADO IS CAUSING INTENSE COMPETITION FOR AVAILABLE LAND RESOURCES. ONE FORM OF COMPETITION POSING SERIOUS PROBLEMS IS INDISCRIMINATE DEVELOPMENT OF FLOOD PLAINS ALONG CREEKS AND RIVERS. THIS MAP DEPICTS A BROAD-SCALE VIEW OF FLOOD-PRONE AREAS ALONG PRINCIPAL STREAMS IN THE GREATER DENVER

AREA OF THE URBAN CORRIDOR. FLOOD-PRONE AREAS IDENTIFIED ARE SUBJECT TO INUNDATION BY THE 100-YEAR FLOOD--A FLOOD HAVING A 1 PERCENT CHANCE OF BEING EQUALED OR EXCEEDED IN ANY GIVEN YEAR. THE MAGNITUDE AND DEPTH OF THIS REFERENCE FLOOD WERE DERIVED FOR STREAMS IN THE STUDY AREA FROM STREAMFLOW RECORDS AND REPORTS OF THE U.S. GEOLOGICAL SURVEY, REPORTS OF THE U.S. ARMY CORPS OF ENGINEERS, AND FROM REPORTS PREPARED BY VARIOUS CONSULTING ENGINEERING FIRMS FOR THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT. (WOODARD-USGS)

Exploratory drilling in the Coalmont Coalfield, Jackson County, Colorado
Madden, D. H., 1977a
U.S. Geological Survey Open-File Report 77-887, 138 p.

Exploratory drilling in the McCallum Coalfield
Madden, D. H., 1977b
U.S. Geological Survey Open-File Report 77-888, 80 p.

THE EAGLE VALLEY EVAPORITE, NORTHWEST COLORADO-A REGIONAL SYNTHESIS
MALLORY, W. W.
GEOLOGICAL SURVEY, WASHINGTON, D.C. BULLETIN 1311-E, 1971. 37 P, 8 FIG, 3 PLATE, 1 TAB, 31 REF.,
Journal Announcement: SWRA0423

THE EAGLE VALLEY EVAPORITE OF NORTHWEST COLORADO CONSISTS PRINCIPALLY OF GYPSUM AND ANHYDRITE, BUT CONTAINS AN APPRECIABLE QUANTITY OF HALITE AND TRACES OF POTASH SALTS. THE ENCLOSING ROCKS ARE CONGLOMERATE, SANDSTONE, SILTSTONE, SHALE, AND LIMESTONE. THE AGE OF THE FORMATION IS MIDDLE PENNSYLVANIAN, LATE ATOKA, AND DES MOINES. THE THICKNESS OF THE EVAPORITE INTERVAL RANGES FROM 9,000 FEET IN THE VICINITY OF EAGLE, COLO., TO ZERO AT THE NORTHEASTERN EDGE OF THE EAGLE BASIN, 25 MILES AWAY. IN SOME AREAS FLOWAGE HAS INCREASED ORIGINAL DEPOSITIONAL THICKNESS. BECAUSE OF ITS PLIABILITY, THE EVAPORITE IS DEFORMED MORE THAN OTHER ROCKS IN ITS VICINITY. IT SHOWS THE EFFECTS OF LOAD METAMORPHISM, LARAMIDE TILTING, DIAPIRIC UPWELLING, AND CONTORTION DUE TO FLOWAGE AND HYDRATION OF ANHYDRITE. THE EVAPORITE WAS DEPOSITED IN A LANDLOCKED MARINE TROUGH BETWEEN THE UNCOMPAHGRE AND FRONTRANGE UPLIFTS. MARINE CIRCULATION AND INTERCHANGE OF WATER WERE IMPEDED ON THE OPEN NORTHWEST END BY A BROAD, SHALLOW SHELF, WHILE EXCEPTIONALLY THICK EVAPORITE ROCKS WERE DEPOSITED AT OCCASTIONAL TORRENTIAL RAIN. MINERAL COMMODITIES OF POSSIBLE FUTURE COMMERCIAL VALUE, CONTAINED IN OR ASSOCIATED WITH THIS FORMATION, ARE GYPSUM, HALITE, SALTS OF POTASSIUM, OIL AND GAS. (WOODARD-USGS)

Coal of the Denver Basin, Colorado
Martin, G. C., 1913

U.S. Geological Survey Bulletin 381-C, illus., tables, p. 297-306.

THERMODYNAMIC CONSTRAINTS ON METAL SOLUBILITIES IN A STREAM AFFECTED BY MINE DRAINAGE, BONANZA, COLORADO
MORAN, R. E.; WENTZ, D. A.
GEOLOGICAL SURVEY, DENVER, COLO.
IN: WATER RESOURCES PROBLEMS RELATED TO MINING: AMERICAN WATER RESOURCES ASSOCIATION PROCEEDINGS SERIES NO 18, P 54-64, JUNE 1974. 8 FIG, 1 TAB, 15 REF.,
Journal Announcement: SWRA0908
DRAINAGE FROM ABANDONED METAL MINES AND TAILINGS PILES HAS RESULTED IN ACID, METAL-LIFEROUS SURFACE WATER IN THE VICINITY OF BONANZA, COLO. MUCH OF THE STREAMBED IS COATED WITH AMORPHOUS FE(OH)3 THAT CONTAINS SIGNIFICANT CONCENTRATIONS OF OTHER METALS. USING THERMODYNAMIC TECHNIQUES, IT WAS FOUND THAT SEVERAL COMPOUNDS OTHER THAN FE(OH)3 COULD BE PRECIPITATING. THESE COMPOUNDS INCLUDE CU2(OH)2CO3, CU3(OH)2(CO3)2, CU3(OH)4SO4, CU4(OH)6SO4.H2O, MNCO3, AND ZN2SIO4. SOLUBILITY PRODUCTS WERE NOT EXCEEDED FOR ANY OF THE CADMIUM, LEAD, OR NICKEL COMPOUNDS CONSIDERED. (WOODWARD-USGS)

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado, (Duplicated see Utah).
Naten, R. W.; Fuller, R. H.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Geological Survey Open-File Report 81-644 (WRI), 1981. 38 p, 26 Fig, 4 Tab, 12 Ref.,
Journal Announcement: SWRA1512

HYDROLOGIC RECONNAISSANCE OF THE SOUTHERN UINTA BASIN, UTAH AND COLORADO. (Duplicated see Utah).
PRINCE, D.; MILLER, L. L.,
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
UTAH DEPARTMENT OF NATURAL RESOURCES, SALT LAKE CITY, TECHNICAL PUBLICATION NO 49, 1975. 66 P, 11 FIG, 3 PLATE, 15 TAB, 38 REF.,
Journal Announcement: SWRA0821

The Trinidad coal field, Colorado
Richardson, G. B., 1910
U.S. Geological Survey Bulletin 381, p. 379-446.

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado
Robson, S. G.; Saulnier Jr, G. J.

Geological Survey, Lakewood, CO. Water Resources Div.

Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.25. Geological Survey Professional Paper 1196, 1981. 65 p, 45 Fig, 4 Tab, 64 Ref.,

Journal Announcement: SWRA1502

Oil-shale mining activities in Piceance basin in northwestern Colorado could adversely affect the ground- and surface-water quality in the basin. This study of the hydrology and geochemistry of the area used ground-water solute-transport-modeling techniques to investigate the possible impact of the mines on water quality. Maps of the extent and structure of the aquifer were prepared and show that a saturated thickness of 2,000 feet occurs in the northeast part of the basin. Ground-water recharge in the upland areas in the east, south, and west parts of the basin moves down into deeper zones in the aquifer and laterally to the discharge areas along Piceance and Yellow Creeks. The saline zone and the unsaturated zone provide the majority of the dissolved solids found in the ground water. Precipitation, ion-exchange, and oxidation-reduction reactions are also occuring in the aquifer. Model simulations of ground-water pumpage in tracts C-a and C-b indicate that the altered direction of ground-water movement near the pumped mines will cause an improvement in ground-water quality near the mines and a degradation of water quality downgradient from the tracts. Model simulations of mine leaching in tract C-a and C-b indicate that equal rates of mine leaching in the tracts will produce much different effects on the water quality in the basin. Tract C-a, by virtue of its remote location from perennial streams, will primarily degrade the ground-water quality over a large area to the northeast of the tract. Tract C-b, by contrast, will primarily degrade the surface-water quality in Piceance Creek, with only localized effects on the ground-water quality. (USGS)

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado

Robson, S. G.; Saulnier, G. J. Jr

Geological Survey, Lakewood, CO. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $12.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-72, April, 1980. 89 p, 45 Fig, 4 Tab, 65 Ref.,

Journal Announcement: SWRA1412

Oil-shale mining activities in Piceance basin in northwestern Colorado could adversely affect the ground- and surface-water quality in the basin. This study of the hydrology and geochemistry of the area used groundwater solute-transport-modeling techniques to investigate the possible impact of the mines on water quality. Maps of the extent and structure of the aquifer were prepared and show that a saturated thickness of 2,000 feet occurs in the northeast part of the basin. Ground-water recharge in the upland areas in the east, south, and west parts of the basin moves down into deeper zones in the aquifer and laterally to the discharge areas along Piceance and Yellow Creeks. The saline zone and the unsaturated zone provide the majority of the dissolved solids found in the ground water. Precipitation, ion-exchange, and oxidation-reduction reactions are also occurring in the aquifer. Model simulations of groundwater pumpage in tracts C-a and C-b indicate that the altered direction of groundwater movement near the pumped mines will cause an improvement in groundwater quality near the mines and a degradation of water quality downgradient from the tracts. Model simulations of mine leaching in tract C-a and C-b indicate that equal rates of mine leaching in the tracts will produce much different effects on the water quality in the basin. Tract C-a, by virtue of its remote location from perennial streams, will primarily degrade the groundwater quality over a large area to the northeast of the tract. Tract C-b, by contrast, will primarily degrade the surface-water quality in Piceance Creek, with only localized effects on the groundwater quality. (USGS)

Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado

Robson, S. G.; Wacinski, A.; Zawistowski, S.; Romero, J. C.

Geological Survey, Lakewood, CO. Water Resources Div., and Colorado Dept. of Natural Resources, Denver.

Available from Br. of Dist. USGS, Box 25286, Fed. Ctr., Denver, CO 80225, Price: 7.50. Geological Survey Hydrologic Investigations Atlas HA-650, 1981. 3 Sheets, 13 Fig, 1 Tab, 11 Ref.,

Journal Announcement: SWRA1509

The Laramie-Fox Hills aquifer underlies an area of about 6,700 square miles in east-central Colorado and is an important water supply for many residents in the area. Population increases have produced increasing demands for ground water and have led to significant water-level declines in parts of the aquifer. Results of this study, which was undertaken to better define the water-supply potential of the aquifer, indicate that the aquifer consists of interbedded sandstone, siltstone and shale at depths of as much as 3,200 feet. The water-yielding sandstone and siltstone beds have a total thickness of more than 200 feet in some areas. The 1978 potentiometric-surface map indicates that ground water moves from the south-central part of the aquifer toward the margins of the aquifer where most of the water discharges to streams and alluvial aquifers. Some groundwater recharge occurs as downward movement of water from the overlying Arapahoe aquifer. Water-level declines between 1958 and 1978 exceeded 200 feet in an 80-square-mile area near Brighton, while in other aquifer is generally of a sodium bicarbonate type with dissolved-solids concentrations commonly ranging from 400 to 1,200 milligrams per liter. (USGS)

Correlation of shallow lignite beds in the Denver Formation near Watkins, Colorado, using lithologic and gamma ray logs.
Sanchez, J. D., 1976
U.S. Geological Survey Open-File Report 76-279.

Chemical analysis, physical property tests, and lithologic description of cores and cuttings of lignite and overburden rocks from an area near Watkins, Colorado
Sanchez, J. D., and Hobbs, R. G., 1977
U.S. Geological Survey Open-File Report 77-628, 22 p.

Water-Supply Assessment of the Laramie-Fox Hills Aquifer in Parts of Adams, Boulder, Jefferson, and Weld Counties, Colorado
Schneider, P. A. Jr
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $13.50 in paper copy, $6.50 in microfiche. Geological Survey Open-File Report 80-327 (WRI), 1980. 17 p, 2 Fig, 6 Plates, 2 Tab, 12 Ref.,
Journal Announcement: SWRA1411

Groundwater in the Laramie-Fox Hills aquifer is a potential source of supplemental municipal water supplies for the communities of Erie, Lafayette, Louisville, and Superior in Colorado. The present water supplies for these communities are not always adequate to meet current demands. The U.S. Geological Survey made a water-supply assessment of the Laramie-Fox Hills aquifer for the U.S. Bureau of Reclamation, which is investigating and evaluating alternative sources of water for the communities. Recharge to the aquifer is mostly in the western and southwestern parts of the study area. Groundwater movement is generally from the southwest to northeast. Groundwater discharge in the study area is primarily by pumping wells. Since 1961, this pumping has caused water-level declines of about 250 to 300 feet from Broomfield to east of Erie, Colorado. Generally, water levels in other parts of the area have remained the same. The aggregate sand thickness determined from well logs ranges from 42 to 360 feet and the mean thickness is 229 feet. The volume of groundwater in storage in the study area is about 5 million acre-feet. Reported yields from 93 wells ranged yields tended to be larger in the areas where aggregate sand thickness is the greatest. The water generally changes from a sodium calcium bicarbonate type to a sodium calcium sulfate type as it moves through the aquifer away from the recharge areas. The maximum limit established by the U.S. Environmental Protection Agency for nitrite plus nitrate in public-water supplies was exceeded in water from three wells, the maximum limit for fluoride was exceeded in water from two wells, and the maximum limit for selenium was exceeded in water from three wells. (USGS)

Hydrologic Data for Water-Table Aquifers in the Boulder--Fort Collins--Greeley Area, Front Range Urban Corridor, Colorado
Schneider, P. A. Jr; Hillier, D. E.
Geological Survey, Lakewood, CO. Water Resources Div.
Availability: OFSS, USGS Box 25425, Dep. Fed. Ctr. Denver, CO., 80225, Paper copy $12.00, microfiche $4.00. Geological Survey open-file report 78-567, July 1978. 55 p, 2 fig, 1 plate, 2 tab, 6 ref.,
Journal Announcement: SWRA1212
As part of the U.S. Geological Survey's investigations of the hydrology and geology in the Front Range Urban Corridor of Colorado, hydrologic data relating to water-table aquifers were compiled during 1976-77. These data consisting of records of 446 wells and chemical analyses of water from 208 wells in the Boulder--Fort Collins--Greeley area, are presented in tabular form. The well-data tables contain records that were collected during 1976-77. The chemical analysis tables contain records that were collected during 1956-77. State and local officials in the Boulder--Fort Collins--Greeley area may find these data useful in planning for residential, commercial, and industrial development. (Woodard-USGS)

Preliminary geologic map and lignite deposits of the Strasburg NW quadrangle, Arapahoe and Adams Counties, Colorado
Soister, P. E., 1972
U.S. Geological Survey Open-File Report, geologic map, scale 1:24,000, 2 sheets graphic coal sections.

A preliminary report on a zone containing thick lignite beds Denver Basin, Colorado
Soister, Paul E., 1974
U.S. Geological Survey Open-File Report (this report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards), 46 p. plus 1 p. addendum.

A preliminary report on a zone containing thick lignite beds, Denver Basin, Colorado
Soister, P. E., 1974
U.S. Geological Survey Open-File Report 74-27, 4 tables, 6 figures, 64 p., geologic map scale 1:250,000.

An Overview of River-Basin Assessment Techniques in an Energy-Impacted Region--Yampa River Basin, Colorado and Wyoming
Steele, T. D.
Geological Survey, Lakewood, CO.
Water Supply and Management, Vol 3, No 3, p 151-171, 1979. 10 Fig, 2 Tab, 29 Ref.,

Journal Announcement: SWRA1308

With increasing development of coal production, there is concern over increased water demand and anticipated environmental impacts associated with coal mining, particularly in the Rocky Mountain States which have small populations and limited water resources. These assessment studies focus on the Yampa River basin in northwestern Colorado and south-central Wyoming, and involve that part of the basin east of Dinosaur National Monument. Objectives include: (1) to evaluate the environmental and economic impacts of regional energy- and water-resource development for existing and feasible alternative policies, and (2) to describe the assessment methodologies used so that they may be applied to other energy-rich regions of the western U.S. where water resources are limited. The major energy resource in the basin consists of near-surface coal deposits; other resources--oil and gas, oil shale, uranium and geothermal springs--also occur in the basin. The regional-appraisal and modeling studies used in this assessment are: ambient stream quality, stream traveltime and re-aeration characteristics, waste-load assimilative capacity, sediment loadings in streams, reservoir-modeling analysis, groundwater solute transport, remote-sensing applications and air quality modeling. In this assessment concern was given to projected increased water uses and how they are to be met within existing use patterns and other institutional constraints. Continuing studies such as these will enable resource managers to anticipate potential problems concerning the impending coal-resource development in the Yampa River basin. (Iervolino-NC)

An Overview of River-basin Assessment Techniques in an Energy-Impacted Region--Yampa River Basin, Colorado and Wyoming

Steele, T. D.

Geological Survey, Denver, CO.

Water Supply and Management, Vol 3, No 3, p 151-171, 1979. 10 Fig, 2 Tab, 29 Ref.,

Journal Announcement: SWRA1305

Reported here are the results of completed basin assessment studies of the Yampa River Basin in northwestern Colorado and south-central Wyoming that had as their objectives (1) to evaluate the environmental and economic impact of regional energy and water resource development for existing and feasible alternative policies, and (2) to describe the assessment methodologies used so that they may be applied to other energy-rich regions of the western U.S. where water resources are limited. A set of 7 coal-resource development alternatives are specified in order to evaluate the effects of possible water demands and generated residuals on the region's water resources. The resultant analyses consider both the direct effects of coal mining, processing, conversion and transportation and the indirect effects of increased population and related commercial and service needs. Based upon extensive field collection of hydrologic data and the analysis of regional economic projections, a range of impacts of the projected development on the basin's water resources are evaluated using several data-analysis and physical modelling techniques. (Tickes-Arizona)

Coal-Resource Development Alternatives, Residuals Management, and Impacts on the Water Resources of the Yampa River Basin, Colorado and Wyoming

Steele, T. D.

Geological Survey, Lakewood, Colo. Water Resources Div.

Paper presented at Symposium on Water Resources and Fossil Fuel Production, held in Dusseldorf, Germany, September 7-8, 1976: International Water Resources Association, 1976. 14 p, 1 fig, 1 tab, 17 ref.,

Journal Announcement: SWRA1010

Development of coal resources in the Yampa River basin in the southern Rocky Mountains of the United States will have a variety of effects on available water resources. These involve both direct effects caused by coal extraction, processing, transport, and conversion techniques utilized or proposed for the region and also indirect effects associated with regional economic growth. Impacts from both types of effects involve water resources of the basin in terms of water withdrawals, consumptive use, and assimilative capacities of discharged residuals (that is, noneconomic byproducts). A regional residual-management analysis involves assessing mass and energy balances of the primary economic activities, as well as an economic and technical evaluation of alternative strategies of treatment and modification of residuals discharged to the environment from various sources. Approaches and results to date of residuals-management and environmental-modeling techniques are described for evaluating water-resources impacts of coal-related development in the Yampa River basin, Colorado and Wyoming. (Woodard-USGS)

Assessment Techniques for Modeling Water Quality in a River Basin Affected by Coal-Resource Development

Steele, T. D.

Geological Survey, Lakewood, CO. Water Resources Div.

Paper presented at: Symposium on Modeling the Water Quality of the Hydrological Cycle, International Association of Hydrological Sciences and International Institute for Applied Systems Analysis, Baden, Austria, September 11-15, 1978. 16 p, 6 fig, 1 tab, 22 ref.,

Journal Announcement: SWRA1210

A regional water-resources assessment in the Yampa River basin, Colorado and Wyoming, used modeling techniques applied in five component studies to evaluate direct and indirect impacts of coal-resource development. Modeling of the waste-load assimilative capacity of the Yampa River indicated exceedence of a proposed standard for nonionized ammonia concentration using assumptions of anticipated population growth and treatment-plant effluents. Traveltimes for a 50-kilometer reach of the Yampa River ranged from 15.7 hours for seasonal high flow of 28 cubic meters per second to 120 hours for a low flow of 0.6 cubic meter per second; measured reaeration coefficients for selected subreaches ranged from 6.04 to 33.4 per day. Modeling of alternative configurations of proposed reservoirs indicated a reduction of annual time-weighted dissolved-solids concentrations downstream by an estimated 34 percent. By 1990, an increase of between 9 and 27 thousand metric tons of sediment derived from surface-mined areas is estimated to be transported annually in basin streams. Model simulations of a hypothetical 5,000 milligrams per liter conservative contaminant predicted its direction, rate, and dispersion in one of the major coal-bearing aquifers during a 200-year period. The benefits of integrating physically based modeling components for assessing regional water-resources management alternatives are demonstrated. (Woodard-USGS)

AN ENVIRONMENTAL ASSESSMENT OF IMPACTS OF COAL DEVELOPMENT ON THE WATER SOURCES OF THE YAMPA RIVER BASIN, COLORADO AND WYOMING--PHASE-1 WORK PLAN
STEELE, T. D.; BAUER, D. P.; WENTZ, D. A.; WARNER, J. W.
GEOLOGICAL SURVEY, DENVER, COLO.
OPEN-FILE REPORT 76-367, MAY 1976. 17 P, 2 FIG, 3 TAB, 11 REF.,
Journal Announcement: SWRA0919

COAL RESOURCES OF THE WESTERN UNITED STATES ARE BEING DEVELOPED AT EVER-INCREASING RATES, CAUSING CONCERNS OF THE EFFECTS OF MINING AND ASSOCIATED ACTIVITIES ON THE ENVIRONMENT. THE YAMPA RIVER BASIN IN NORTHWESTERN COLORADO AND SOUTH-CENTRAL WYOMING IS UNDERGOING ECONOMIC DEVELOPMENT OF ITS COAL, OIL AND GAS, AND URANIUM RESOURCES. THE YAMPA RIVER BASIN ASSESSMENT IS A 2.5-YEAR PROGRAM OF THE U.S. GEOLOGICAL SURVEY. IT IS DESIGNED PRIMARILY TO ASSESS THE AVAILABILITY AND QUALITY OF THE BASIN'S WATER RESOURCES. THE BASIN ASSESSMENT ALSO WILL EVALUATE POTENTIAL ENVIRONMENTAL AND SELECTED SOCIOECONOMIC IMPACTS OF ENERGY-RESOURCE DEVELOPMENT PLANS PROPOSED BY MINING AND POWER COMPANIES. THIS REPORT SERVES AS A PROJECT WORK PLAN FOR THE BASIN ASSESSMENT'S FIRST-PHASE WORK ACTIVITIES. (WOODARD-USGS)

The Yampa River Basin, Colorado and Wyoming--a Preview to Expanded Coal-Resource Development and its Impacts on Regional Water Resources
Steele, T. D.; Bauer, D. P.; Wentz, D. A.; Warner, J. W.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-300 815, Price codes: A07 in paper copy, A01 in microfiche. Geological Survey Water-Resources

Investigations 78-126, September 1979. 133 p, 35 Fig, 16 Tab, 124 Ref.,

Journal Announcement: SWRA1307

Expanded coal production and conversion in the Yampa River basin, Colorado and Wyoming, may have substantial impacts on water resources, environmental amenities, and socioeconomic conditions. Preliminary results of a 3-year basin assessment by the U.S. Geological Survey are given for evaluation of surface- and ground-water resources using available data, modeling analysis of waste-load capacity of a Yampa River reach affected by municipal wastewater-treatment plant effluents, and semiquantitative descriptions of ambient air- and water-quality conditions. Aspects discussed are possible constraints on proposed development due to basin compacts and laws regulating water resources, possible changes in environmental-control regulations, and policies on energy-resource leasing and land use that will influence regional economic development. (Woodard-USGS)

AN ENVIRONMENTAL ASSESSMENT OF IMPACTS OF COAL DEVELOPMENT ON THE WATER RESOURCES OF THE YAMPA RIVER BASIN, COLORADO AND WYOMING--PHASE-II WORK PLAN

STEELE, T. D.; JAMES, I. C. II; BAUER, D. P.

GEOLOGICAL SURVEY, DENVER, COLO.

OPEN-FILE REPORT 76-368, MAY 1976. 33 P, 2 FIG, 2 TAB, 60 REF.,

Journal Announcement: SWRA0921

THE YAMPA RIVER BASIN ASSESSMENT IN COLORADO AND WYOMING IS A 2.5-YEAR PROGRAM OF THE U.S. GEOLOGICAL SURVEY. IT IS DESIGNED PRIMARILY TO ASSESS THE AVAILABILITY AND QUALITY OF THE BASIN'S WATER RESOURCES. THE BASIN ASSESSMENT ALSO WILL EVALUATE POTENTIAL ENVIRONMENTAL AND SELECTED SOCIOECONOMIC IMPACTS OF ENERGY-RESOURCE DEVELOPMENT PLANS PROPOSED BY MINING AND POWER COMPANIES. THIS REPORT SERVES AS A PROJECT WORK PLAN FOR THE BASIN ASSESSMENT. IT DESCRIBES THE PROGRAM OBJECTIVES, AND THE VARIOUS APPROACHES OF ANALYSIS AND EVALUATION. ENVIRONMENTAL STUDIES ARE OUTLINED FOR ANALYZING BOTH THE DIRECT EFFECTS OF VARIOUS PROPOSALS REGARDING COAL MINING, TRANSPORTATION, AND CONVERSION, AND THE SECONDARY EFFECTS RESULTING FROM INCREASED POPULATION AND URBAN GROWTH. THE BASIN ASSESSMENT IS DESIGNED TO PROVIDE FEDERAL, STATE AND LOCAL DECISION-MAKERS WITH THE BASIC ENVIRONMENTAL INFORMATION NEEDED TO FORMULATE AND TO EVALUATE POLICIES FOR THE DEVELOPMENT OF ENERGY RESOURCES. THE TECHNIQUES APPLIED AND CONCLUSIONS REACHED IN THE YAMPA RIVER BASIN ASSESSMENT SHOULD AID SIMILAR STUDIES IN OTHER ENERGY-RICH BASINS IN THE WESTERN UNITED STATES. (WOODARD-USGS)

Hydrologic Reconnaissance of the Yampa River During Low Flow, Dinosaur National Monument, Northwestern Colorado

Steele, T. D.; Wentz, D. A.; Warner, J. W.

Geological Survey, Lakewood, CO. Water Resources Div.

Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, Colo. 80225; paper copy, $1.75; microfiche, $3.50.,

Journal Announcement: SWRA1122

A hydrologic reconnaissance of a 74-kilometer reach of the Yampa River in Dinosaur National Monument in Colorado was made during the low flow in mid-August 1976. Stream discharge, which was measured every 16 to 24 kilometers, ranged from 9.4 to 10.6 cubic meters per second. Variations in streamflow were explained, in part, by underflow, loss to ground water, and evaporation. Specific conductance was measured about every 2 kilometers and indicated a downstream increase on the order of 11 to 12 percent for the reach. Except for mercury, bottom-sediment trace-element concentrations in the study reach were less than maximum concentrations determined during August-September 1976 for bottom sediments at unperturbed sites upstream in the Yampa River basin. At one of five sampling sites, the mercury concentration in bottom sediments exceeded the maximum measured upstream level. (Woodard-USGS)

MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE GREATER DENVER AREA, FRONT RANGE URBAN CORRIDOR, COLORADO

TRIMBLE, D. E.; FITCH, H. R.

GEOLOGICAL SURVEY, DENVER, COLO.

FOR SALE BY USGS, RESTON, VA., 22092, PRICE $1.75. MISCELLANEOUS INVESTIGATIONS SERIES MAP I-856-A, 1974. 1 SHEET, 1 MAP, 1 TAB, 33 REF.,

Journal Announcement: SWRA0924

HIGH-QUALITY GRAVEL IN THE FRONT RANGE URBAN CORRIDOR, COLO., IS RESTRICTED LARGELY TO AREAS BENEATH FLOOD PLAINS OF MAJOR STREAMS AND TO LOW TERRACES ALONG THESE STREAMS. ROCK SUITABLE FOR PROCESSING INTO CRUSHED-ROCK AGGREGATE IS PLENTIFUL IN THE OLDER ROCKS OF THE MOUNTAINS AND IN CERTAIN VOLCANIC ROCKS OF THE FOOTHILLS AND PLAINS. POTENTIAL SOURCES OF GRAVEL OR OF AGGREGATE HAVE BEEN GROUPED INTO SEVEN MAP UNITS--THREE OF GRAVEL AND FOUR OF CRUSHED-ROCK AGGREGATE. A POTENTIAL SOURCE OF GRAVEL, AS HERE DEFINED AND MAPPED, CONTAINS 20 PERCENT OF MORE OF GRANULE-AND PEBBLE-SIZE STONES (SMALLER THAN 2.5 IN. OR 6.4 CM, BUT RETAINED ON A NO. 10 U.S. STANDARD SIEVE). THE MINIMUM GRAVEL CONTENT WAS PLACED ARBITRARILY AT 20 PERCENT OF THE DEPOSIT BECAUSE THIS IS THE MOST LIKELY ECONOMIC LIMIT UNDER THE MOST ADVERSE FORESEEABLE CONDITIONS. THE MAP UNITS ARE BASED ON DIFFERENCES IN PHYSICAL CHARACTERISTICS, WHICH, IN TURN, DETERMINE RELATIVE QUALITY FOR DIFFERENT USES. (WOODARD-USGS)

Water-Quality Characteristics of Six Small, Semiarid Watersheds in the Green River Coal Region of Colorado

Turk, J. T.; Parker, R. S.

Geological Survey, Lakewood, CO. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-207390, Price codes: A06 in paper copy, A01 in microfiche. Water-Resources Investigations 81-19, 1982. 96 p, 6 Fig, 8 Tab, 10 Ref.,

Journal Announcement: SWRA1601

Analysis of major and trace constituents in streams flowing through six semiarid watersheds indicates that the stream chemistry is characterized by saturation with respect to common carbonate minerals (calcium, magnesium, iron, manganese, and lead). The solubility of the carbonate minerals may be a major control on the absolute and relative concentrations of calcium, magnesium, bicarbonate, iron, manganese, and lead; however, other mechanisms probably control the concentrations of cadmium and zinc. Statistical analyses indicate that the mean concentrations of the major ions in the two climatic areas studied are significantly (P=0.05) different from one another, with larger mean concentrations in the more arid area. Trace-metal concentrations were similar from one area to another and indistinguishable from site to site (P=0.05) for lead, cadmium, and zinc. Linear regressions of major ion concentration to specific conductance are similar in both areas for sodium, bicarbonate, sulfate, and chloride. Results of the study may be useful in providing a first approximation of stream chemistry in other watersheds with the same geologic setting, determining watersheds with similar geochemical controls, and determining future changes in stream chemistry in the watersheds studied. (USGS)

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado

Turk, J. T.

Geological Survey, Denver, CO.

Water Resources Bulletin, Vol 18, No 1, p 75-80, February, 1982. 4 Fig, 2 Tab, 8 Ref.,

Journal Announcement: SWRA1512

Coal production in Colorado has increased significantly in the period since 1965, raising questions concerning the effects of mine drainage on water quality. Major dissolved ions that contribute to the overall salinity of the water, restricting its suitability for various uses, are frequently found in water from underground coal mines. Thermodynamics provides an effective tool for the assessment of the origin of seepage from underground coal mines and for prediction of compliance with water quality criteria of seepage from other mines within the same geologic formations. Analysis of samples from 13 of the 14 mines studied indicated that calite saturated water had probably reacted with sodium rich marine shales to produce the seepage, which was saturated or supersaturated with respect to calcite. Samples showing evidence of being most completely reacted were composed almost entirely of sodium and bicarbonate ions and had a calcium to sodium activity ratio similar to that of seawater. The one sample not saturated with calcite was saturated with respect to gypsum, probably as a result of simple dissolution of gypsum from the strata through which the groundwater percolated.

The primary problems which might result from reuse of the mine drainage would be damage or destruction of crops if the drainage water were used for irrigation. Also, the chloride and sulfate concentrations in some samples were in excess of recommended standards for public water supplies. (Carroll-FRC)

Appraisal of Ground Water in the Vicinity of the Leadville Drainage Tunnel, Lake County, Colorado

Turk, J. T.; Taylor, O. J.

Geological Survey, Lakewood, CO. Water Resources Div.

Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $3.50 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-1538, November 1979. 24 p, 10 Fig, 5 Tab, 13 Ref.,

Journal Announcement: SWRA1324

Ground water in the Leadville mining district occurs in granite, quartzite, limestone, sandstone, porphyry dikes, and unconsolidated material. These rocks form a single aquifer system because the formations are hydraulically connected through contact, mine workings, faulting, and fracturing. The aquifer is recharged by precipitation and water moves toward California Gulch and probably toward Evans Gulch, in the drainage basin of the Arkansas River. The Leadville drainage tunnel was constructed from 1943 to 1945 and later extended during 1950 to 1952, in order to drain the mine workings. Discharge from the tunnel lowered water levels 30 to 96 feet in mine shafts from 1944 to 1951. Installation of an impervious plug in the tunnel has been proposed in order to reduce the discharge of water containing objectionable concentrations of trace metals into the East Fork Arkansas River. The proposed plug would reduce the discharge from the tunnel, cause water levels east of the town of Leadville to rise, flood some mine workings, and increase ground-water discharge to California Gulch. However, the proposed plug is not expected to cause water levels in Leadville to rise substantially, but more current and detailed data are needed to verify this. Discharge from the Leadville drainage tunnel is probably a mixture of water in equilibrium with carbonate aquifer materials from the mineralized zone, water acidified by the localized oxidation of pyrite from the mineralized zone, and water nearly saturated with calcite from the glacial mantle. Based on limited data, water from the carbonate mineral deposits has a pH of about 7.0 and concentrations of manganese of about 1,800 micrograms per liter and zinc concentrations of about 13,000 micrograms per liter. (USGS)

Coal energy development in Moffat and Routt Counties of the Yampa River basin in Colorado-Projected primary and secondary economic impacts resulting from several coal-development futures

Udis, Bernard, Adams, T. H., Hess, R. C., and Orr, D. V., 1977

U.S. Geological Survey Contract Completion Report P. O. 12185, 342 p.

The South Park Coal field, Colorado, in, Campbell, Marius R., geologist in charge, Contributions to economic geology 1908, Part II- Mineral Fuels
Washburne, Chester W., 1910
U.S. Geological Survey Bulletin 381, p. 307-316.

Digital Model of Ground-Water Flow in the Piceance Basin, Rio Blanco and Garfield Counties, Colorado
Weeks, J. B.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22151 as PB-284 341, Price codes: A06 in paper copy, A01 in microfiche. Water-Resources Investigations 78-46, June 1978. 108 p, 6 fig, 2 tab, 12 ref.,
Journal Announcement: SWRA1124
The digital model used to simulate ground-water flow in the aquifer system in the basin drained by Piceance and Yellow Creeks in northwestern Colorado is described in detail. The model is quasi three-dimensional in that it simulates ground-water flow in a multiaquifer system by assuming horizontal flow in the aquifers and vertical flow through the confining layers separating the aquifers. The model uses the iterative alternating-direction implicit procedure to solve the finite-difference flow equations. The digital model is documented by a program listing and flow charts. Data used in the model and sample output are presented to document the simulation of steady-state flow in the aquifer system. The variables used in the computer program and program options are discussed in detail. (Woodard-USGS)

HYDROLOGIC AND GEOPHYSICAL DATA FROM THE PICEANCE BASIN, COLORADO
WEEKS, J. B.; WELDER, F. A.
GEOLOGICAL SURVEY, DENVER, COLO.
COLORADO DEPT. OF NATURAL RESOURCES, DENVER, COLORADO WATER RESOURCES BASIC-DATA RELEASE NO 35, 1974. 121 P, 21 FIG, 5 PLATE, 70 TAB.,
Journal Announcement: SWRA0806
POTENTIAL OIL-SHALE DEVELOPMENT AND THE NEED FOR INFORMATION ON THE WATER RESOURCES OF THE PICEANCE BASIN, COLORADO, LED TO A COOPERATIVE PROJECT BETWEEN THE COLORADO DEPARTMENT OF NATURAL RESOURCES AND THE U.S. GEOLOGICAL SURVEY TO PROVIDE THE DATA NEEDED TO EVALUATE THE EFFECTS OF FUTURE DEVELOPMENT ON THE HYDROLOGY OF THE PICEANCE BASIN. DATA ARE FROM 97 WELLS, 6 SPRINGS, AND 37 CONTINUING SURFACE-WATER STATIONS. MISCELLANEOUS MEASUREMENTS OF DISCHARGE AND SPECIFIC CONDUCTANCE IN STREAMS ARE ALSO GIVEN. INCLUDED IN THIS REPORT ARE

GROUNDWATER AND SURFACE-WATER DATA COLLECTED BY THE U.S. GEOLOGICAL SURVEY IN COOPERATION WITH PRIVATE COMPANIES. SOME OF THE DATA WERE COLLECTED IN COOPERATION WITH THE U.S. ATOMIC ENERGY COMMISSION, THE U.S. BUREAU OF MINES, THE U.S. BUREAU OF LAND MANAGEMENT, THE COLORADO RIVER WATER CONSERVATION DISTRICT, AND THE COLORADO WATER CONSERVATION BOARD. (KNAPP-USGS)

HYDRAULIC TESTING AND SAMPLING OF HOLES RB-E-01 AND RB-D-01, PROJECT RIO BLANCO, RIO BLANCO COUNTY, COLORADO
WEIR, J. E. JR
GEOLOGICAL SURVEY, LAKEWOOD, COLO.
AVAILABLE FROM NTIS, SPRINGFIELD, VA. 22151 - PRICE $3.00 PRINTED COPY; $1.45 MICROFICHE. CONTRACT REPORT USGS-474-150, (RIO BLANCO-1) FOR US ATOMIC ENERGY COMMISSION, NOVEMBER 1972. 28 P, 6 FIG, 2 TAB, 3 REF. USAEC CONTRACT AT(29-2)-474.,
Journal Announcement: SWRA0718

THE DISCHARGE OF WATER WAS MONITORED DURING DRILLING OF TWO HOLES (RB-E-01 AND RB-D-01) AT THE RIO BLANCO SITE IN WESTERN COLORADO. RECOVERY OF WATER LEVEL WAS MEASURED FOLLOWING PERIODS OF WATER WITHDRAWAL FROM HOLE RB-D-01. TWO INTERVALS OF HOLE RB-D-01 WERE TESTED. ZONE 1, FROM 245 TO 845 FEET BELOW LAND SURFACE, HAS A TRANSMISSIVITY OF ABOUT 4,600 GALLONS PER DAY PER FOOT AND A STATIC WATER LEVEL OF 59.90 FEET BELOW LAND SURFACE. ZONE 2, FROM 882 TO 1,651 FEET BELOW LAND SURFACE, HAS A TRANSMISSIVITY OF ABOUT 200 GALLONS PER DAY PER FOOT AND A STATIC WATER LEVEL OF 39.63 FEET BELOW LAND SURFACE. THERE IS POTENTIAL AT HOLE RB-D-01 FOR FLOW OF WATER UPWARD FROM ZONE 2 TO ZONE 1; HOWEVER, DIFFERENCES IN QUALITY OF WATER IN THE TWO ZONES INDICATE THAT WATER PROBABLY DOES NOT CIRCULATE FREELY BETWEEN THE ZONES. (KNAPP-USGS)

HYDRAULIC TESTING ACCOMPANYING DRILLING OF FIVE EXPLORATORY HOLES, PICEANCE CREEK BASIN, COLORADO
WEIR, J. E. JR; DINWIDDIE, G. A.
GEOLOGICAL SURVEY, LAKEWOOD, COLO.
AVAILABLE FROM NTIS, SPRINGFIELD, VA., 22151 AS USGS-3002-2 PRICE $5.45 PRINTED COPY; $1.45 MICROFICHE. CONTRACT REPORT USGS-3002-2, SEPTEMBER 1973. 55 P, 40 FIG, 1 TAB, 1 REF. AEC CONTRACT NO. AT(49-16)-3002.,
Journal Announcement: SWRA0701

FIVE EXPLORATORY CORE HOLES WHICH PENETRATED ALLUVIUM AND THE GREEN RIVER FORMATION WERE DRILLED IN THE PICEANCE CREEK BASIN, COLORADO, AND HYDROLOGIC INFORMATION WAS OBTAINED DURING DRILLING. TRANSMISSIVITY OF THE ROCKS TESTED WAS LOW (LESS THAN 7,500 GALLONS PER DAY PER FOOT). FIELD CONDUCTANCE OF FLUID DISCHARGED DURING DRILLING RANGED FROM ABOUT 500 TO ABOUT 29,000 MICROMHOS PER CENTIMETER. GENERAL CONCLUSIONS, BASED ON COMPARISON AND EVALUATION OF AVAILABLE DATA, ARE THAT (1) THE ROCKS HAVING GREATEST PERMEABILITY PENETRATED BY THE FIVE TEST HOLES ARE ABOVE THE MAHOGANY

LEDGE ZONE IN THE UPPER PART OF THE PARACHUTE CREEK MEMBER OF THE GREEN RIVER FORMATION; (2) GROUNDWATER IN THE PENETRATED ROCKS BECOMES MORE MINERALIZED WITH DEPTH, NOTICEABLY AT AND BELOW THE MAHOGANY LEDGE ZONE; AND (3) THE TEST HOLES PROBABLY ARE IN AN AREA OF POTENTIAL GROUNDWATER DISCHARGE. (WOODARD-USGS)

APPRAISAL OF SHALLOW GROUND-WATER RESOURCES, PUEBLO ARMY DEPOT, COLORADO
WELDER, F. A.; HURR, R. T.
GEOLOGICAL SURVEY, DENVER, COLO. WATER RESOURCES DIV.
GEOLOGICAL SURVEY OPEN-FILE REPORT 71006, DECEMBER 1971, 44 P, 10 FIG, 5 PLATE, 5 TAB, 7 REF.,
Journal Announcement: SWRA0517

THE WATER SUPPLY FOR THE PUEBLO ARMY DEPOT, 15 MILES EAST OF PUEBLO, COLO., IS OBTAINED FROM WELLS THAT TAP AN AQUIFER IN TERRACE ALLUVIUM. ADVERSELY AFFECTS THE DISCHARGE RATE OF INDIVIDUAL WELLS. FURTHERMORE, EXCESSIVE PUMPAGE HAS RESULTED IN PROGRESSIVE DETERIORATION OF WATER THE DEPOT AND WERE TESTED TO DETERMINE AQUIFER PROPERTIES AND PROBABLE YIELDS. THE HYDRAULIC CONDUCTIVITY DETERMINED FROM THESE TESTS RANGED FROM ABOUT 350 TO NEARLY 600 GALLONS PER DAY PER SQUARE FOOT. THE TRANSMISSIVITY FOR THE FULL THICKNESS OF THE AQUIFER IS IN THE RANGE OF 7,500 TO 12,000 GALLONS PER DAY PER FOOT. THE TWO NEW SUPPLY WELLS CAN BE PUMPED AT A COMBINED RATE OF ABOUT 140 GALLONS PER MINUTE. IF PUMPAGE IN THE EXISTING WELL FIELD IS REDUCED BY THE SAME AMOUNT, SOME RECOVERY OF WATER LEVELS IN THE FIELD WILL OCCUR AND THE TREND IN WATER QUALITY DETERIORATION MAY SLOW OR EVEN REVERSE. (WOODARD-USGS)

Geohydrologic Data from Twenty-Four Test Holes Drilled in the Piceance Basin, Rio Blanco County, Colorado, 1975-76
Welder, F. A.; Saulnier, G. J. Jr
Geological Survey, Lakewood, CO. Water Resources Div.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225 Paper copy $20.75, microfiche $3.50. Geological Survey open-file report 78-734, September 1978. 132 p, 73 fig, 31 tab, 21 ref.,
Journal Announcement: SWRA1211

Twenty-four test holes were drilled in the Piceance basin, northwestern Colorado, to obtain geohydrologic data from the Uinta and Green River Formations of Eocene age. Depths of test holes ranged from 640 to 2,800 feet. The maximum quantity of water discharged during the air drilling of individual test holes ranged from 14 to 880 gallons per minute. The specific conductance of water discharged during drilling ranged from 100 to 50,000 micromhos per centimeter at 25 degrees Celsius. Aquifer tests made during drilling indicate transmissivity at four sites ranged from 100 to 1,600 feet squared per day and the storage coefficient at two sites ranged from 0.0004 to 0.00016. Depths to the static water level ranged from 30 to 695 feet. Water levels were measured in each test well, and potentiometric maps constructed from these measurements are comparable in configuration and altitude to those previously drawn from composite-head data. Water samples taken during drilling indicate that, except for water from the Uinta Formation, the water in Piceance basin is generally not suited for domestic water supply due to the presence of excessive amounts of certain trace constituents, notably fluoride. The average concentration of dissolved solids, based on data from the test holes, was 909 milligrams per lower part of the Parachute Creek Member. (Woodard-USGS)

Metamorphism and structural history of the Coal Creek area, Front Range, Colorado, in short papers in the geologic and hydrologic sciences, Article 196
Wells, J. D., Sheridan, D. M., and Albee, A. L., 1961
U.S. Geological Survey Professional Paper 424-C, p. C127.

EFFECT OF MINE DRAINAGE ON THE QUALITY OF STREAMS IN COLORADO, 1971-72
WENTZ, D. A.
GEOLOGICAL SURVEY, LAKEWOOD, COLO.
COLORADO WATER RESOURCES CIRCULAR NO 21, 1974. 117 P, 9 FIG, 3 PLATE, 12 TAB, 93 REF, APPEND.,
Journal Announcement: SWRA0717

MINE DRAINAGE IN COLORADO IS COMMONLY ACID WATER CONTAINING HIGH CONCENTRATIONS OF IRON AND SULFATE. THE OXIDATION OF METAL SULFIDES UNDER ACID CONDITIONS RELEASES HIGH CONCENTRATIONS OF TRACE ELEMENTS TO THE WATER. FIELD OBSERVATIONS OF TEMPERATURE, SPECIFIC CONDUCTANCE, PH, STREAM-BOTTOM CONDITIONS, AND AQUATIC BIOTA AT 995 STREAM SITES IN COLORADO DURING 1971-72 WERE USED AS A GUIDE IN COLLECTING 192 SAMPLES FOR ANALYSIS OF SULFATE AND DISSOLVED TRACE ELEMENTS. APPROXIMATELY 450 MILES OF STREAMS IN 25 DIFFERENT AREAS ARE ADVERSELY AFFECTED BY METAL-MINE DRAINAGE. OF THE TRACE ELEMENTS FOR WHICH THE U.S. PUBLIC HEALTH SERVICE HAS ESTABLISHED DRINKING WATER STANDARDS, CADMIUM EXCEEDS ITS LIMIT IN MORE THAN 12% OF THE SAMPLES, WHILE ARSENIC AND LEAD EXCEED THEIR LIMITS IN 1-3% OF THE SAMPLES. MERCURY AND SILVER STANDARDS ARE NOT SURPASSED; CHROMIUM WAS NOT DETECTED. COPPER AND ZINC APPEAR TO PRESENT THE GREATEST DANGER INSOFAR AS TOXICITY TO RESIDENT AQUATIC LIFE IS CONCERNED. ACID PRODUCTION IS LESS OF A PROBLEM IN COLORADO STREAMS DRAINING METAL-MINING AREAS THAN IN STREAMS DRAINING THE COAL-MINING AREAS OF APPALACHIA. (KNAPP-USGS)

STREAM QUALITY IN RELATION TO MINE DRAINAGE IN COLORADO
WENTZ, D. A.
GEOLOGICAL SURVEY, DENVER, COLO.
IN: WATER RESOURCES PROBLEMS RELATED TO MINING: AMERICAN WATER RESOURCES ASSOCIATION PROCEEDINGS SERIES NO 18, P 158-173, JUNE 1974. 5 FIG, 5 TAB, 31 REF.,
Journal Announcement: SWRA0908

MOST OF COLORADO'S METAL DEPOSITS ARE COMPOSED OF SULFIDE ORES.

OXIDATION OF ASSOCIATED PYRITE YIELDS ACIDIC WATER, WHICH IN TURN DISSOLVES OTHER METAL SULFIDES AND RELEASES TRACE ELEMENTS TO THE SURFACE DRAINAGE. THE PROCESS IS RELATIVELY UNIMPORTANT IN COAL DEPOSITS WITHIN THE STATE. TRACE ELEMENTS IN COLORADO STREAMS DO NOT OFTEN FOLLOW A NORMAL OR SIMPLE LOGNORMAL FREQUENCY DISTRIBUTION. CONCENTRATIONS OF CADMIUM, COBALT, COPPER, IRON, LEAD, MANGANESE, MOLYBDENUM, NICKEL, VANADIUM, AND ZINC OCCUR IN GREATER CONCENTRATIONS IN STREAMS DRAINING METAL-MINING AREAS THAN IN STREAMS DRAINING COAL-MINING OR CONTROL AREAS. OF THESE, CADMIUM, COBALT, COPPER, MANGANESE, NICKEL, AND ZINC TEND TO OCCUR TOGETHER. ARSENIC, CHROMIUM, MERCURY, SELENIUM, AND SILVER DO NOT SEEM TO OCCUR AT ANOMALOUSLY HIGH LEVELS IN METAL- OR COAL-MINING AREAS. BASED ON THIS STUDY, IT IS SUGGESTED THAT FIELD MEASUREMENTS OF SPECIFIC CONDUCTANCE AND PH CAN BE USED AS A GUIDE IN THE SELECTION OF STREAMS AFFECTED BY METAL MINING. VISUAL OBSERVATIONS OF STREAM CONDITIONS CAN ALSO HELP. IN SITUATIONS WHERE VISUAL OBSERVATIONS ARE DIFFICULT (FOR EXAMPLE, GROUNDWATER STUDIES), MEASUREMENT OF ONE OR MORE INDICATOR CHEMICAL CONSTITUENTS MAY BE FEASIBLE. IN COLORADO, ZINC, AND POSSIBLY SULFATE, MIGHT BE USED IN THIS REGARD. (WOODARD-USGS)

Analysis of Stream Quality in the Yampa River Basin, Colorado and Wyoming

Wentz, D. A.; Steele, T. D.

Geological Survey, Lakewood, CO. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-108904, Price codes: A08 in paper copy, A01 in microfiche. Geolgical Survey Water-Resources Investigations 80-6, April 1980. 161 p, 80 Fig, 17 Tab, 59 Ref.,

Journal Announcement: SWRA1404

Historic data show no significant water-temperature changes since 1951 for the Little Snake or Yampa Rivers, the two major streams of the Yampa River basin in Colorado and Wyoming. Regional analyses indicate that harmonic-mean temperature is negatively correlated with altitude. No change in specific conductance since 1951 was noted for the Little Snake River; however, specific conductance in the Yampa River has increaed 14% since that time and is attributed to increased agricultural and municipal use of water. Site-specific relationships between major inorganic constituents and specific conductance for the Little Snake and Yampa Rivers were similar to regional relationships developed from both historic and recent (1975) data. These relationships provide a means for estimating concentrations of major inorganic constituents from specific conductance, which is easily measured. Trace-element and nutrient data collected from August 1975 through September 1976 at 92 sites in the Yampa River basin indicate that water-quality degradation occurred upstream from 3 sites. The degradation resulted from underground drainage from pyritic materials that probably are associated with coal at one site, discharge from powerplant cooling-tower blowdown water at a second site, and runoff from a small watershed containing a gas field at the third site. Ambient concentrations of dissolved and total iron and manganese frequently exceeded proposed Colorado water-quality standards. The concentrations of many dissolved and total trace elements and nutrients were greatest during March 1976. These were associated with larger suspended-sediment concentrations and smaller pH values than at other times of the year. (USGS)

Surface-Water Quality in the Yampa River Basin, Colorado and Wyoming--An Area of Accelerated Coal Development
Wentz, D. A.; Steele, T. D.
Geological Survey, Lakewood, Colo. Water Resources Div.
Paper presented at: Conference on Water for Energy Development, Engineering Foundation, Asilomar Conference Grounds, Pacific Grove, California, December 5-10, 1976. 28 p, 11 fig, 1 tab, 4 ref.,
Journal Announcement: SWRA1022

Coal production in the Yampa river basin of Colorado and Wyoming is expected to exceed 20 million tons annually by 1990. Increased coal production and related development could increase withdrawals of surface water, which currently (1976) supplies the bulk of water used in the basin. Analyses have been carried out to determine ambient surface-water quality in the basin prior to accelerated coal-resource development. Regional temperature patterns, sediment yields, and relations between specific conductance and concentrations of major inorganic chemical constituents have been determined from available historical data. Time-trend analyses of historical stream temperatures at the mouths of the two main subbasins show no discernible changes since 1951. Over the same period, there has been a 14-percent increase in dissolved-solids concentration in one subbasin, although no change has occurred in the other. The historical data were complemented by a reconnaissance of 82 stream sites during low-flow conditions in August and September 1975. At three sites, concentrations of trace elements in water and in bottom sediments were higher than ambient levels determined for the basin. Iron and manganese concentrations exceeded current drinking water standards recommended by the U.S. Public Health Service (1962) at 40 sites; high concentrations of nitrogen, phosphorous, and organic carbon were found at six sites. Diversity indices for benthic macroinvertebrates provide no concrete evidence for additional anomalous sites in the basin. (Woodard-USGS)

SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES--RIO GRANDE REGION
WEST, S. W.; BROADHURST, W. L.
GEOLOGICAL SURVEY, RESTON, VA.
AVAILABLE FROM SUPT. OF DOCUMENTS, GPO, WASHINGTON, D.C.

20402 - PRICE $1.75. PROFESSIONAL PAPER 813-D, 1975. 39 P, 21 FIG, 2 TAB, 154 REF.,

Journal Announcement: SWRA0821

THE RIO GRANDE IS AN INTERSTATE AND INTERNATIONAL STREAM WHICH BEGINS IN HIGH MOUNTAINS OF COLORADO, FLOWS ACROSS NEW MEXICO, AND FORMS THE BOUNDARY BETWEEN TEXAS AND MEXICO. ANNUAL PRECIPITATION ON THE REGION IS ABOUT 86 MILLION ACRE-FEET; HOWEVER, ALL BUT 4 MILLION ACRE-FEET IS RETURNED TO THE ATMOSPHERE BY EVAPOTRANSPIRATION. THE GROUNDWATER RESERVOIRS CONTAIN AN AGGREGATE OF 5,800 MILLION ACRE-FEET OF FRESH AND SLIGHTLY SALINE WATER IN STORAGE, WHICH COULD BE WITHDRAWN THROUGH WELLS. IN CONTRAST, THE SURFACE RESERVOIRS HAVE A COMBINED STORAGE CAPACITY OF ONLY 18 MILLION ACRE-FEET. WITHDRAWAL OF GROUNDWATER IN 1970 WAS 2.7 MILLION ACRE-FEET, OF WHICH 88% WAS USED FOR IRRIGATION. THE REGION APPEARS TO OFFER SEVERAL POSSIBILITIES FOR UTILIZING UNDERGROUND SPACE FOR PURPOSES OTHER THAN THE WITHDRAWAL OF WATER, SUCH AS WASTE DISPOSAL, ARTIFICIAL RECHARGE, WATER-QUALITY CONTROL, AND DEVELOPMENT OF GEOTHERMAL ENERGY. (WOODARD-USGS)

Geology and coal resources of the Gulnare, Cuchara Pass, and Stonewall area, Huerfano and Las Animas Counties, Colorado

Wood, G. H., Jr., Johnson, R. B., and Dixon, G. H., 1956

U.S. Geological Survey Coal Investigations Map C-26, scale 1:31,680, 2 sheets.

Geology and coal resources of the Starkville-Weston area, Las Animas County, Colorado

Wood, G. H., Jr., Johnson, R. B., and Dixon, G. H., 1957

U.S. Geological Survey Bulletin 1051, 68 p.

Geology and coal resources of the Stonewall-Tercio area, Las Animas County, Colorado

Wood, G. H., Jr., Johnson, R. B., Eargle, D. H., Duggner, R. T., and Major, Harold, 1951

U.S. Geological Survey Coal Investigations Map C-4, scale 1:31,680, 2 sheets.

HYDROLOGIC DATA FROM THE PICEANCE BASIN, COLORADO

GEOLOGICAL SURVEY, DENVER, COLO.

COLORADO DEPT OF NATURAL RESOURCES, DENVER, COLORADO WATER RESOURCES BASIC-DATA RELEASE NO 31, J. F. FICKE, J. B. WEEKS AND F. A. WELDER, COMPILERS, 1974. 246 P, 80 FIG, 91 TAB.,

Journal Announcement: SWRA0713

WATER DATA COLLECTED IN AND COMPILED FOR THE PICEANCE BASIN, COLORADO, ARE PRESENTED. INCLUDED ARE GROUNDWATER AND SURFACE-WATER DATA COLLECTED BY THE GEOLOGICAL SURVEY AND

PRIVATE COMPANIES. GROUNDWATER DATA WERE COLLECTED FROM 52 WELLS IN THE PICEANCE BASIN. OF THE 52 WELLS, 25 WELLS HAVE TRANSMISSIVITY DATA, 16 WELLS HAVE DISCHARGE DATA, 39 WELLS HAVE TEMPERATURE DATA, 8 WELLS HAVE VERTICAL FLOW DATA, 37 WELLS HAVE SPECIFIC CONDUCTANCE DATA, 17 WELLS HAVE COMMON ION DATA, AND 18 WELLS HAVE TRACE ELEMENT DATA. A POTENTIOMETRIC MAP OF THE REPORT AREA IS GIVEN. THE MAP IS BASED ON THE ALTITUDE OF WATER LEVELS IN 51 OBSERVATION WELLS WHICH PENETRATE THE GREEN RIVER FORMATION. THE WATER-LEVEL MEASUREMENTS WERE MADE DURING THE SUMMER OF 1972. (KNAPP-USGS)

Hydrologic Studies of the U.S. Geological Survey Related to Coal Development in Colorado
Geological Survey, Lakewood, Colo. Water Resources Div.
Open-file report 76-549, August 1976. 22 p, 5 fig.,
Journal Announcement: SWRA1006

This report summarizes the hydrologic studies related to coal development being conducted by the U.S. Geological Survey in the State of Colorado. The objective of the hydrologic data-acquisition program is to collect surface-water quality and quantity data and ground-water level records. These data are needed to define predevelopment conditions and to monitor the effects of construction and operation of coal mines and waste-disposal areas. Data-acquisition activities related to coal development in Colorado have concentrated on the Yampa River basin. A description of the hydrologic data-acquisition activities, including parameters collected and frequency of collection, precedes the summaries of the three interpretive studies currently in progress. Each study summary consists of the project title, definition of the problem being studied, objective of the study, approach of the study, and when known, the schedule for completion of the study and proposed report products resulting from the study. (Woodard-USGS)

PUBLICATIONS OF WATER RESOURCES INVESTIGATIONS IN COLORADO AND SELECTED PUBLICATIONS PERTAINING TO COLORADO
GEOLOGICAL SURVEY, DENVER, COLO. WATER RESOURCES DIV.
GEOLOGICAL SURVEY, COLORADO DISTRICT REPORT, 1973. 33 P.,
Journal Announcement: SWRA0620

THE WATER-RESOURCES PROGRAM OF THE U.S. GEOLOGICAL SURVEY CONSISTS OF THE COLLECTION OF BASIC INFORMATION THROUGH ITS HYDROLOGIC-DATA STATIONS, AREAL HYDROLOGIC AND INTERPRETIVE STUDIES, AND RESEARCH PROJECTS. THE BASIC DATA COLLECTED, THE RESULTS OF THE AREAL STUDIES, AND THE RESEARCH FINDINGS ARE PRESENTED MAINLY IN PUBLICATIONS OF THE U.S. GEOLOGICAL SURVEY AND COLORADO AGENCIES, BUT SOME APPEAR ALSO IN TECHNICAL JOURNALS AND OTHER PUBLICATIONS. THIS LIST CONTAINS PUBLICATIONS OF WATER-RESOURCES INVESTIGATIONS IN COLORADO THAT ARE EITHER PUBLISHED OR IN PREPARATION AND SELECTED PUBLICATIONS PERTAINING TO COLORADO. (WOODARD-USGS)

Foidel Creek Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in Route County, northwestern Colorado
BLM, Denver, Colorado
EMRIA Report No. 6-76

The 4.36-square-mile Foidel Creek study site includes much of the ephemeral and intermittent headwater drainage to Foidel Creek. Relief in less than 2 miles is 1080 feet. Annual precipitation is about 16 inches. Runoff occurs only in spring from snowmelt and spring rains. The Wadge coal in the Williams Fork Formation of the Mesaverde Group dips northwestward, as does much of the surface, and contains 31 million tons of coal no deeper than 201.3 feet. Small quantities of water, less than 10 gallons per minute to wells, occur in thin discontinuous sandstone layers above, within and below the coal. The water is not highly mineralized, containing only hundreds of milligrams per liter total dissolved solids. Surface mining spoil will increase dissolved solids content of ground water. Proper operational and restoration practices should minimize or eliminate erosion and addition of sediment downstream.

Lay Creek Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in Moffat County, northwestern Colorado
BLM, Denver, Colorado
EMRIA Report No. 20-78

The 5.7 square-mile Lay Creek site consists mostly of "badlands" between gently sloping valley bottoms and steep slopes leading to 40-foot vertical escarpments of narrow dissected mesas. The site is drained by through-flowing Lay and Bond Creeks, both ephemeral. Annual runoff is probably less than 200 acre-feet. The coal is in the Fort Union Formation, which slopes gently northward from the Mud Springs anticline. Strippable coal resources in the Emerson and Blevens beds from 6.5 to more than 25 feet thick amount to 142 million tons. Small amounts of water occur in alluvium, good quality, and in the coals (dissolved solids, 900 to 1,400 milligrams per liter). Mining would remove 4 small stock reservoirs which could be replaced readily. No significant hydrologic impacts are foreseen.

Northwest Colorado Coal
BLM, Craig, Colorado
FES, undated (1976?)

This document addresses impacts of approval of mine plans in existing Federal leases, grants of associated rights-of-way, and possible future leasing, in

Moffat and Routt Counties, in Colorado. Federal action would result in annual coal production of 15.7 billion tons by 1980, and 24.8 billion tons by 1990. The coal would be mined both by underground and surface methods. Precipitation ranges from less than 8 inches to more than 24 inches annually. The area is drained almost entirely by the Yampa and White Rivers--major tributaries to the Green River flowing into the Colorado River in southeastern Utah. The northwest corner of the area is drained by intermittent Vermillion Creek into the Green River. Water yields range from less than one inch of runoff in desert areas to more than 20 inches from areas at higher elevations. Total dissolved solids range from 50 to 500 milligrams per liter in streams of the area. Major water use in the area is for irrigation, which together with saline ground water inflow are the major causes of salinity (283 tons per day). Mining would add 5,000 tons per year of dissolved load and less than 30,000 tons of sediment annually to the Colorado River System by the year 1990, resulting in an insignificant, less than 1 milligram per liter increase in dissolved solids below Hoover Dam. Ground water occurs throughout the area in limited quantity, ranging from less than a gallon per minute from shale areas, to several tens of gallons per minute in coarser sedimentary rock units, to 1,500 gallons per minute from the Mississippian-age Madison Limestone and alluvium of larger streams. Quality ranges from less than 20 to more than 5,000 milligrams per liter of dissolved solids. Impacts of mining on ground water would be localized to the loss of a few wells and springs.

Taylor Creek Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in the Axial Basin Coal Field, northwestern Colorado
BLM, Denver, Colorado
EMRIA Report No. 3-75

The 2,000-plus acre Taylor Creek Study site in Moffat County, northwestern Colorado is on the southern flank of the Axial Basin. Its rolling hills and sloping ridges are drained by minor ephemeral tributaries to the Yampa River, 8 to 10 miles north. The coals beneath the site are in the lower part of the Williams Fork Formation of the Upper Cretaceous Mesaverde Group. Coal seams within 200 feet of land surface range up to 12 feet thick and are separated by thin to thick layers of shale, siltstone and fine-grained sandstone layers. Thicker coal seams occur at greater depths. Water, perched on impermeable layers, is commonly found within 30 feet of the surface. Sustainable well yields probably would not exceed 5 gallons per minute. Small, manageable quantities of water may be encountered while surface mining. Proper operation and reclamation practices would reduce or eliminate increases in sediment to streams.

West-central Colorado Coal
BLM, Montrose, Colorado
FES, Undated (1978?)

This statement evaluates impacts of six underground mine and reclamation plans in a seven-county area of west-central Colorado. Elevations and annual precipitation range from 4,300 feet and 10 inches on the west at the Utah border, to 14,000 feet and 35 inches in the east near the Continental Divide. The mines are in the Little Book Cliffs, Grand Mesa, Somerset, and Carbondale coal fields. Most of the coal is in the Cretaceous Mesaverde Group/Formation but in the Little Book Cliffs Field, some of the coal is in the Anchor Mine Tongue of the underlying Mancos Shale. The area is in the Colorado Plateau and Eastern Rocky Mountain Provinces, and includes the southern Piceance and eastern Uinta Basins. The proposed mines would produce 10.54 million tons of coal by the year 1990. All mine entry would be from outcrops on valley sides. The major rivers draining the area are the Colorado, Gunnison and Uncompahgre. Slopes are sparsely vegetated and erode easily. Major river alluvium generally yields less than 25 gallons per minute but rarely as much as 500 gallons per minute to wells. Some terrace deposits yield up to 1,000 gallons per minute to wells but the deposits are soon drained. Water quality is generally poor because of irrigation. Wells in coals and related sandstone layers generally yield less than 10 gallons per minute. Coals and sandstones are generally drained near outcrops. Groundwater provides 0.4 percent of the area's water yield and 1.3 percent of its total dissolved solids. Mining would affect coal and sandstone aquifers in less than 0.08 percent of the study area, and would affect no existing wells. Mining could disturb stream channels in 0.03 percent of the study area. Water consumption could reduce water yield to Upper Colorado mainstem by 3,920 acre-feet per year, or 0.09 percent, and increase salt load by 0.26 milligrams per liter, 0.05 percent, at the state line, and 0.16 milligrams per liter, 0.02 percent, below Hoover Dam. Sediment yield would decrease during mining but after return to normal. Statement includes site-specific assessments of the six proposed mines.

Westmoreland Short-term Coal Lease
BLM, Montrose, Colorado
EAR, 1977

This record assesses the impacts of leasing 2,230 acres of Federal coal, three miles northwest of Paonia, Delta County, Colorado. The coal would be mined underground as an extension of existing Orchard Valley mine. The coal is the 26-foot thick "D" seam of the Mesa Verde Paonia Shale Member dipping 3 to 6 degrees northwestward on the southern flank of the Piceance Basin. Overburden ranges from zero at the outcrop to 2,000 feet three miles north.

Initial drilling disclosed no groundwater system and no major aquifers are anticipated. Water requirements of 45 acre-feet per year (28 gallons per minute) may be obtained from nearby Stevens Gulch alluvium. Testing 2 indicated transmissivities ranging from 1,057 to 1,750 gallons per day per foot, and storage coefficients ranging from 0.0003 to 0.004. Water from two wells in the alluvium contained 405 milligrams per liter of dissolved solids, mostly bicarbonate. Diversions and sediment retention dams would maintain the local environmental condition of the water resources.

Coal Amendment to the Williams Fork Management Framework Plan
BLM, Craig, Colorado
MFP-CA, 1982

This document ammends the Williams Fork Management Framework Plan. The study area, 5,707 acres in Moffat and Routt Counties, 20 miles southwest of Steamboat Springs in northwestern Colorado, includes 5,063 acres of Federal coal potentially suitable for surface or underground mining. Parts of Fish and Middle Creek flood plains are considered unsuitable for coal mining or associated surface disturbance where 100-year flood depths would exceed 3 feet. Sixty acres along Fish Creek are alluvial valley floors considered unsuitable if mining would interrupt, discontinue or preclude farming. The remaining land would be evaluated for suitability in detail in site-specific environmental impact statements if leased, and mine plans would be environmentally assessed.

GROUNDWATER GEOLOGY OF THE ROCK ISLAND, MONMOUTH, GALESBURG, AND KEWANEE AREA, ILLINOIS
BRUECKMANN, JOHN E.; BERGSTROM, ROBERT E.
ILLINOIS STATE GEOLOGICAL SURVEY, URBANA.
ILLINOIS GEOLOGICAL SURVEY REPORT OF INVESTIGATIONS 221, 1968. 56 P, 14 FIG, 3 TAB, 44 REF, APPEND.,
Journal Announcement: SWRA0324

GROUNDWATER IN THE ROCK ISLAND, MONMOUTH, GALESBURG, AND KEWANEE AREA, ILLINOIS, IS OBTAINED FROM (1) SAND AND GRAVEL AQUIFERS WITHIN THE GLACIAL DRIFT; (2) SHALLOW BEDROCK AQUIFERS THAT ARE PRIMARILY DOLOMITE OF THE NIAGARAN SERIES (SILURIAN) AND THE KEOKUK-BURLINGTON LIMESTONE (MISSISSIPPIAN); AND (3) DEEP BEDROCK AQUIFERS, PRIMARILY THE ORDOVICIAN ANCELL GROUP (GLENWOOD-ST. PETER SANDSTONE) AND THE CAMBRIAN IRONTON-GALESVILLE SANDSTONE. MOST PRIVATE WATER SUPPLIES GENERALLY ARE OBTAINED FROM THE DEEP BEDROCK AQUIFERS. SAND AND GRAVEL AQUIFERS ARE SPARSELY DISTRIBUTED IN THE AREA. THE ESTIMATED TOTAL PUMPAGE OF GROUNDWATER ALONE IS 16,531,000 GALLONS PER DAY FOR THE AREA. THIS CONSTITUTES ABOUT 50% OF THE ESTIMATED TOTAL PUMPAGE OF BOTH SURFACE AND GROUNDWATER AND SERVES ABOUT 63% OF THE POPULATION. MUNICIPALITIES NOW USING GROUNDWATER CAN PROBABLY DEVELOP ADDITIONAL GROUNDWATER SOURCES TO MEET INCREASED DEMANDS IN THE FUTURE. (KNAPP-USGS)

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Magnitude and Frequency of Floods in Illinois
Carns, J. M.
U.S. Geological Survey, 599 p.

This report presents flood-peak data and methods of estimating the magnitude and frequency of floods for most streams in Illinois.

Flood-frequency curves are given for gaged sites where 10 or more years of flood records have been collected. Flood characteristics from these curves were related, by multiple-regression analysis, to drainage basin characteristics. Regional equations are presented which relate flood-peak discharges to recurrence intervals of 1.25, 2, 5, 10, 25, 50, and 100 years using drainage area, main-channel slope, rainfall intensity, and a regional factor as independent variables. These equations can be used to estimate the magnitude and frequency of floods at most ungaged sites where flood discharges are not significantly affected by regulation or urbanization. Graphs are presented for estimating flood magnitudes on some streams where the regional equations are not applicable.

The report contains a compilation of peak stages and discharges at gaging stations having 5 or more years of record. Where available, all floods above a selected base are included in the tabulations. Only the annual maximum floods are shown for other stations.

Frequency Analysis of Illinois Floods Using Observed and Synthetic Streamflow Records
Curtis, George W.
U.S. Geological Survey Water-Resources Investigations 77-104, 1977, 32 p.
Equations, applicable Statewide, for estimating flood magnitudes having recurrence intervals ranging from 2 to 500 years for unregulated rural streams, with drainage areas ranging from 0.02 to 10,000 square miles (0.05 to 25,900 square kilometers), were derived by multiple regression analyses. A rainfall-runoff model was used in the synthesis of long-term annual peak data for each of 54 small watersheds (drainage areas less than 10.2 square-miles, 26.4 square-kilometers). Synthetic frequency curves generated from five long-term precipitation stations were combined into one synthetic curve and then this synthetic curve was combined with the observed station frequency curve to define the station frequency curve. Synthetic data from the 54 small streams, observed data at 33 small streams, and observed data at 154 large streams were used in the analyses. The most significant independent variables in the regression analysis for estimating flood peaks on Illinois streams were drainage area, slope, rainfall intensity, and an areal factor.

Technique for estimating magnitude and frequency of floods in Illinois
Curtis, G. W., 1977
U.S. Geological Survey Water Resources Investigations 77-117, 70 p.

Time of Concentration and Storage Coefficient Values for Illinois Streams
Graf, Julia B., Garklavs, George, and Oberg, Kevin A.
U.S. Geological Survey Water-Resources Investigations 82-13, March 1982, 35 p.
Values of time of concentration and storage coefficient, two unit hydrograph parameters, are presented for 194 and 120 basins in Illinois, respectively. Tabulated values consist of those computed by previous investigators as well as those computed for 98 basins as part of this investigation. These additional values were computed by calibration of the U.S. Army Corps of Engineers Flood Hydrograph Package (HEC-1). The significance of differences in method used by each investigator to compute these unit hydrograph parameters was evaluated by statistical comparison of four sets of time of concentration values and three sets of storage coefficient values. Because no difference due to method was identified, it is concluded that all of the values in table 1 in this report can be used in any application for which time of concentration and storage coefficient are required.

A Technique for Estimating Time of Concentration and Storage Coefficient Values for Illinois Streams

Graf, Julia B., Garklavs, George, and Oberg, Kevin A.
U.S. Geological Survey Water-Resources Investigations 82-22, March 1982, 10 p.

Values of the unit hydrograph parameters time of concentration (TC) and storage coefficient (R) can be estimated for streams in Illinos by a two-step technique developed from data for 98 gaged basins in the State. The sum of TC and R is related to stream length (L) and main channel slope (S) by the relation (TC + R sub e = 35.2 L exp(0.39) S exp(-0.78). Regional values of R/(TC + R) are used with values of (TC + R) sub e to compute estimated values of time of concentration (TC sub e) and storage coefficient (Re). The variable R/(TC +R) is not significantly correlated with drainage area, slope, or length, but does exhibit a regional trend. That variable accounts for variations in unit hydrograph parameters caused by physiographic variables such as basin topography, flood plain development, and basin storage characteristics.

Chemical Analyses of Surface Water in Illinois, 1975-77, Volume III, Ohio River Tributaries and Mississippi River Tributaries South of Illinois River Basin
Grason, D.; Healy, R. W.
Geological Survey, Champaign, IL. Water Resources Div.
Available from National Technical Information Service, Springfield, VA 22121 as PB-299 914, Price codes: A11 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-25, 1979. 242 p, 1 Fig, 5 Tab, 3 Ref.,
Journal Announcement: SWRA1304

Samples of surface water were collected and analyzed by the Illinois Environmental Protection Agency. The results from water years 1975 to 1977 are presented in three volumes. The history of sampling and analytical methods used during that period are summarized. Stream discharge data from records of the U.S. Geological Survey are included for all sites where samples were collected at gaging stations or near enough that reliable discharge estimates could be made. Volume III includes Ohio River tributaries and Mississippi River tributaries south of Illinois River basin. (Woodard-USGS)

Chemical Analyses of Surface Water in Illinois, 1975-77, Volume II, Illinois River Basin and Mississippi River Tributaries North of Illinois River Basin
Grason, D.; Healy, R. W.
Geological Survey, Champaign, IL. Water Resources Div.
Available from National Technical Information Service, Springfield, VA 22161 as PB-299 913, Price codes: A13 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-24, 1979. 282 p, 1 Fig, 5 Tab, 3 Ref.,
Journal Announcement: SWRA1304

Samples of surface water were collected and analyzed by the Illinois Environmental Protection Agency. The results from water years 1975 to 1977 are presented in three volumes. The history of sampling and analytical methods used during that period are summarized. Stream discharge data from records of the U.S. Geological Survey are included for all sites where samples were collected at gaging stations or near enough that reliable discharge estimates could be made. Volume II includes the Illinois River basin and Mississippi River tributaries north of Illinois River basin. (Woodard-USGS)

Chemical Analyses of Surface Water in Illinois, 1975-77, Volume I, Des Plaines River Basin and Lake Michigan

Grason, D.; Healy, R. W.

Geological Survey, Champaign, IL. Water Resources Div.

Available from National Technical Information Service, Springfield, VA 22161 as PB-299 912, Price codes: A10 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-23, 1979, 218 p, 1 Fig, 5 Tab, 3 Ref.,

Journal Announcement: SWRA1304

Samples of surface water were collected and analyzed by the Illinois Environmental Protection Agency. The results from water years 1975 to 1977 are presented in three volumes. The history of sampling and analytical methods used during that period are summarized. Stream discharge data from records of the U.S. Geological Survey are included for all sites where samples were collected at gaging stations or near enough that reliable discharge estimates could be made. Volume I includes the Des Plaines River basin and Lake Michigan. (Woodard-USGS)

Chemical Analyses of Surface-Water in Illinois, 1958-74 Volume III

Healy, R. W., and Toler, L. G.

U.S. Geological Survey Water-Resources Investigations 78-24, 1978, 354 p.

Samples of surface water were collected and analyzed by the Illinois Environmental Protection Agency and its predecessor, the Stream Pollution Control Bureau of the Illinois Department of Public Health. The results for the period 1958 to 1974 are presented in tabular form and the history of sampling and analytical methods are summarized. Stream discharge data from records of the U.S. Geological Survey are included for all sites where samples were collected at gaging stations or near enough that reliable discharge estimates could be made.

River Mileages and Drainage Areas for Illinois Streams - Volume 1, Illinois except Illinois River basin

Healy, R. W.

U.S. Geological Survey Water-Resources Investigations 79-110, 1979, 350 p.

River mileages are presented for points of interest on Illinois streams draining 10 square miles or more. Points of interest include bridges, dams, gaging stations, county lines, hydrologic unit boundaries, and major tributaries. Drainage areas are presented for selected sites, including total drainage area for any streams draining at least 100 square miles.

River Mileages and Drainage Areas for Illinois Streams - Volume 2, Illinois River basin
Healy, R. W.
U.S. Geological Survey Water-Resources Investigations 79-111, 1979, 302 p.

River mileages are presented for points of interest on Illinois streams draining 10 square miles or more. Points of interest include bridges, dams, gaging stations, county lines, hydrologic unit boundaries, and major tributaries. Drainage areas are presented for selected sites, including total drainage area for any streams draining at least 100 square miles.

Chemical Analyses of Surface Water in Illinois, 1958-74 Volume I
Healy and L.G. Toler
U.S. Geological Survey Water-Resources Investigations 78-22, 1978, 583 p.

Samples of surface water were collected and analyzed by the Illinois Environmental Protection Agency and its predecessor, the Stream Pollution Control Bureau of the Illinois Department of Public Health. The results for the period 1958 to 1974 are presented in tabular form and the history of sampling and analytical methods are summarized. Stream discharge data from records of the U.S. Geological Survey are included for all sites where samples were collected at gaging stations or near enough that reliable discharge estimates could be made.

Chemical Analyses of Surface Water in Illinois, 1958-74 Volume II
Healy, R. W., and Toler, L. G.
U.S. Geological Survey Water-Resources Investigations 78-23, 1978, 442 p.

Samples of surface water were collected and analyzed by the Illinois Environmental Protection Agency and its predecessor, the Stream Pollution Control Bureau of the Illinois Department of Public Health. The results for the period of 1958 to 1974 are presented in tabular form and the history of sampling and analytical methods are summarized. Stream discharge data from records of the U.S. Geological Survey are included for all sites where samples were collected at gaging stations or near enough that reliable discharge estimates could be made.

HYDROGEOLOGIC DATA FROM FOUR LANDFILLS IN NORTHEASTERN ILLINOIS
HUGHES, G. M.; LANDON, R. A.; FARVOLDEN, R. N.

ILLINOIS STATE GEOLOGICAL SURVEY, URBANA.
ENVIRON GEOL NOTE NO 26, ILL STATE GEOL SURV, MAR 1969. 42 P, 5 FIG, 8 TAB, 2 REF. GRANT NO. 5-D01-01-00006-02.,
Journal Announcement: SWRA0214

SANITARY LANDFILLS AT 4 SITES IN ILLINOIS WERE DRILLED AND SAMPLES OF WATER AND SOLID MATERIALS WERE ANALYZED TO DETERMINE THE HYDROGEOLOGIC CONDITIONS AND EFFECTS OF WASTE DISPOSAL IN GLACIATED TERRAIN. THE TABULATED DATA INCLUDE SITES OF PIEZOMETERS AND SAMPLES, DRILLERS LOGS, SIEVE ANALYSES OF EARTH MATERIALS, CLAY MINERAL ANALYSES, CHEMICAL ANALYSES OF LEACHATE AND GROUNDWATER, AND NEUTRON ACTIVATION ANALYSES. THE LANDFILL MAPS INCLUDE PIEZOMETER LOCATIONS, LOCATIONS OF CROSS SECTIONS, AND WATER TABLE CONTOURS. (KNAPP-USGS)

HYDROGEOLOGY OF SOLID WASTE DISPOSAL SITES IN NORTHEASTERN ILLINOIS
HUGHES, G. M.; LANDON, R. A.; FARVOLDEN, R. N.
ILLINOIS STATE GEOLOGICAL SURVEY, URBANA.
FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, U. S. GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C. 20402 PRICE $1.50. REPORT SW-12D, U.S. ENVIRONMENTAL PROTECTION AGENCY, 1971. 154 P, 28 FIG, 20 TAB, 85 REF, 8 APPEND.,
Journal Announcement: SWRA0510

HYDROGEOLOGIC AND WATER QUALITY STUDIES OF FIVE LANDFILLS IN NORTHEASTERN ILLINOIS WERE CARRIED OUT OVER A FOUR-YEAR PERIOD. THE DISTRIBUTION AND CONCENTRATION OF DISSOLVED SOLIDS IN THE VICINITY OF FOUR OF THESE LANDFILLS WAS CONTROLLED BY THE CONFIGURATION OF THE GROUND-WATER FLOW SYSTEM. THE MAJOR FACTORS INFLUENCING THE ATTENUATION OF THE DISSOLVED SOLIDS AFTER THEY HAVE LEFT THE LANDFILL APPEAR TO BE THE PARTICLE SIZE OF THE EARTH MATERIALS THROUGH WHICH THESE DISSOLVED SOLIDS MOVE AND THE DISTANCE THAT THEY MOVE. PRECIPITATION IN NORTHEASTERN ILLINOIS IS ADEQUATE NATURAL ENVIRONMENT IS NOT CAPABLE OF CONTAINING OR ASSIMILATING THIS LEACHATE THE LANDFILLING OPERATION CAN PROBABLY BE MADE SAFE BY LINING THE DISPOSAL SITE, BY COLLECTING AND TREATING THE LEACHATE OR BY OTHER RELATIVELY SIMPLE ENGINEERING PROCEDURES. (DAVIS-CHICAGO)

Low-Flow Frequencies of Illinois Streams
Lara, O. G.
Illinois State Division of Waterways, 1970, 317 p.

This report contains low-flow data and regionalized low-flow frequency curves for all areas in Illinois where at least five years of record (through 1956) have been collected.

In the first section minimum average flows for periods of 1, 7, 15, 30, 60, 120, and 183 days are tabulated for the benefit of those who are interested in the amount of flow available in the stream with minor or no storage. Data for 12, 24, and 60 months are also included in the tables for those concerned with the minimum expected inflow into large impounding reservoirs. Six separate regionalized frequency curves for each station have been fitted on the plotted data. These curves evaluate the minimum average flow expected in periods of 7, 15, 30, 60, 120, and 183 days respectively.

In the second section a technique is derived to serve as a guide in fitting frequency curves to observed data on a regionalized basis, and for the purpose of extrapolating short-term records. This technique is based on relations empirically developed between low-flow and flow-duration parameters. The advantage of using this approach of regionalization and synthesis of frequency curves is that methods for the synthesis and regionalization of duration curves are already available (Mitchell, 1957), "Flow Duration of Illinois Streams."

Drainage areas for Illinois Streams
Ogata, K. M.
U.S. Geological Survey Water-Resources Investigations 13-75, 1975, 120 p.

Drainage areas were tabulated for all streams in Illinois which drain over 100 square miles, at sites where streamflow data have been collected and at other selected locations. Areas were planimetered on U.S. Geological Survey topographic quadrangle maps and balanced to known areas taken from Smithsonian Geographical Tables of areas of quadrilaterals of the earth's surface (procedures and standards recommended by Subcommittee on Hydrology, Federal Inter-Agency River Basin Committee). Streams are tabulated in sequence; first, the Ohio River basin, followed by the St Lawrence River basin, and finally, the Mississippi River basin. Streams are listed in downstream order, starting at the headwaters; the rank of the stream system within each basin is indicated by indention. At sites where streamflow data had been collected, previously assigned U.S. Geological Survey eight-digit numbers are used. These numbers, which describe unique sites, increase in downstream order. All locations are identified by reference to a town, land-line location, topographic quadrangle, and county at the point where the drainage area was determined. An alphabetical index is provided.

Hydrologic effects of storing liquified sludge in strip-mined land
Patterson, G. L.
U.S. Geological Survey Water Resources Investigations 82-4047., 30 p.

The water table near four sewage sludge storage basins in a strip-mined area of western Illinois, has risen about 10 feet since the basins were constructed in 1971. Two-dimensional modeling of ground-water flow in the mine spoil indicates that the rise is caused by leakage from storage basin 1. The hydrologic-parameter values producing the best fit between computed and observed head values are 7 X 10 exp(-6) feet per second for the hydraulic conductivity of the mine spoil, 4 X 10 exp(-9) feet per second (1.51 inches per year) for the areal recharge rate, and 5.6 X 10 exp(-8) feet per second 21.1 inches per year) for recharge from basin 1. The model indicates that the volume of water leaking from basin 1 is 91,600 cubic yards per year.

The principal components of the sewage sludge after the solids have been removed are alkalinity, nitrogen, phosphorus, and chloride. In ground water away from the storage basins, the principal cation was magnesium, whereas in that near the basins, the principal cation was sodium. Components in higher concentrations near the basins were sodium, alkalinity, and chloride. Sulfate was the principal anion in both areas. Because the sodium and chloride concentrations in the sludge were too low to cause the higher concentrations in the ground water, the strip-mine spoil used in constructing the basins was considered to be the major source of these constituents. This spoil had been moved from its original location and unweathered surfaces exposed, which allowed dissolution of carbonate and chloride and release of sodium through cation exchange.

Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois
Patterson, G. L., Fuentes, R. F., and Toler, L. G.
U.S. Geological Survey Water-Resources Investigations 82-16, August 1982, 30 p.

Analyses of water samples collected at four stream-monitoring stations in an area surface mined for coal and being reclaimed by sludge irrigation show the principal metals to be sodium, calcium, and magnesium and the principal non-metals to be chloride, sulfate, and bicarbonate. Comparisons of yearly mean chemical concentrations show no changing trends since the reclamation began, nor are there apparent differences, attributed to sludge, between stream stations upstream and downstream from the site. Yearly suspended-sediment loads and discharge relationships between stations upstream and downstream from the site also are not notably different. Discharge hydrographs of two tributary streams draining the site show a delayed response to precipitation compared with other streams, owing to the damping effect of several upstream strip-mine lakes.

The shape of the water-table surface generally follows the irregular topography. Monthly water-level fluctuations in wells were dependent on the surface material penetrated (mined or unmined) and their proximity to surface discharge. The largest fluctuations were in unmined land away from discharge, whereas the smallest were in mined land near discharge. The water table is closer to the surface in unmined land than in mined land.

The chemical characteristics of ground water are typical of those in mined areas as shown by high concentrations of sulfate, calcium, magnesium, chloride, iron, zinc, and manganese. However, no changes in ground-water quality attributable to reclamation were identified.

Water Quality in the Sugar Creek Basin, Bloomington and Normal, Illinois
Prugh, Byron J. Jr.
Water-Resources Investigations 78-78, 1978, 40 p.

Sugar Creek, within the twin cities of Bloomington and Normal, Illinois, has differences in water quantity and quality as a result of urban runoff and overflows from combined sewers.

Water-quality data from five primary and eight secondary locations showed three basic types of responses to climatic and hydrologic stresses. Stream temperatures and concentrations of dissolved oxygen, ammonia nitrogen, total phosphorus, biochemical oxygen demand, and fecal bacteria showed seasonal variations. Conductivity (dissolved solids). pH, chloride, and suspended solids concentrations varied more closely with stream discharges. Total organic carbon, total nitrogen, total phosphorus, biochemical oxygen demand, and fecal coliform and fecal streptococcal bacteria concentrations exhibited variations indicative of initial flushing action during storm runoff.

Selected analyses for herbicides, insecticides, and other complex organic compounds in solution and in bed material showed that these constituents were coming from sources other than the municipal sanitary treatment plant effluent. Analyses for 10 common metals: arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, and zinc showed changes in concentrations below the muncipal sanitary plant outfall.

Report.

A proposed streamflow data program for Illinois
Sieber, C. R., 1970
U.S. Geological Survey Open-File Report, 73 p.

Some chemical characteristics of mine drainage in Illinois
Toler, L. G., 1980
U.S. Geological Survey Open-File Report 80-416, 47 pp.

Some chemical characteristics of mine drainage in Illinois
Toler, L. G., 1982
U.S. Geological Survey Water-Supply Paper 2078

Surface mining for coal in Illinois has affected runoff from the mined areas and altered water quality in the streams. Average annual sulfate loads in streams are 3,000-4,000 tons per square mile of mined land in the Big Muddy and Saline River basins in southern Illinois. Relatively high concentrations of dissolved aluminum, arsenic, chromium, copper, iron, manganese, and zinc are commonly associated with concentrations of sulfate greater than about 2,000 milligrams per liter.

GROUNDWATER APPRASIAL OF THE SKILLET FORK BASIN ABOVE WAYNE CITY AND HELM RESERVOIR SITE, ILLINOIS
WATKINS, FRANK A. JR
GEOLOGICAL SURVEY, WASHINGTON, D.C.
US 90TH CONGR, 2ND SESS, SENATE DOC NO 96, VOL 2, APPEND J, P 266-275, 1968. 10 P, 4 FIG, 1 TAB.,
Journal Announcement: SWRA0223
MODERATE TO LARGE SUPPLIES OF GROUNDWATER ARE NOT AVAILABLE IN THE SKILLET FORK BASIN ABOVE WAYNE CITY, ILLINOIS BECAUSE OF THE LACK OF NATURAL SUBSURFACE STORAGE AND PERMEABLE AQUIFERS. THE ONLY MEANS OF OBTAINING WATER SUPPLIES WITH A SUSTAINED YIELD GREATER THAN 1.16 CFS, WHICH REPRESENTS THE STREAMFLOW EXCEEDED 90% OF THE TIME, IS THE CONSTRUCTION OF A RESERVOIR IN THE BASIN TO STORE WATER AND IMPROVE ITS QUALITY. (KNAPP-USGS)

GROUNDWATER APPRAISAL OF THE LITTLE WABASH BASIN ABOVE THE GAGE BELOW CLAY CITY AND THE LOUISVILLE RESERVOIR SITE, ILLINOIS
WATKINS, FRANK A. JR; NYMAN, DALE J.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
US 90TH CONGR, 2ND SESS, SENATE DOC NO 96, VOL 2, APPEND J, P 252-263, 1968. 12 P, 4 FIG, 1 TAB.,
Journal Announcement: SWRA0223
MODERATE TO LARGE SUPPLIES OF GROUNDWATER ARE AVAILABLE FROM SAND AND GRAVEL DEPOSITS IN SOME AREAS OF THE LITTLE WABASH RIVER BASIN, ILLINOIS AND ARE POSSIBLE IN OTHER AREAS IF THE DEPOSITS ARE THICK AND AREALLY EXTENSIVE. DEOXYGENATION IS A PROBLEM IN THE STREAMS, DURING LOW-FLOW PERIODS, FROM ABOVE THE DAMSITE DOWNSTREAM TO AT LEAST THE GAGE BELOW CLAY CITY. AT THE GAGE BELOW CLAY CITY THE TOTAL DISSOLVED SOLIDS ARE AT TIMES GREATER THAN 500 PPM DUE TO HIGH SULFATES OR HIGH CHLORIDES OR BOTH. A DAM AT THE LOUISVILLE SITE WOULD HELP BOTH THESE CONDITIONS. (KNAPP-USGS)

Index to Water Resources Data for Illinois
Winget, D. E.
Geological Survey, Champaign, Ill. Water Resources Div.
Water-Resources Investigations 76-87 (open-file report), 1976. 81 p, 4 tab.,
Journal Announcement: SWRA1006
This index to water resources data for Illinois includes 1,275 sites where surface-water and ground-water data were collected through December 31, 1975. The index is the first comprehensive tabulation of data collected in Illinois by the U.S. Geological Survey; data collection began in 1903. Information included are the county code, drainage area, datum, type of data available, period of record, where data are filed, and the name of the current cooperating agency. The surface-water index is listed sequentially by station number and also alphabetically by station name. Station numbers for the

ground-water index are grouped by counties. The hydrologic unit index shows all sites and is listed by the respective hydrologic boundaries. (Woodard-USGS)

Water Resources Activities in Illinois, published annually since 1976.
Winget, D. E.
Geological Survey, Champaign, IL. Water Resouces Div.
Illinois District reports.
These reports detail the activities of the U.S. Geological Survey, Water Resources Division in Illinois.
(Woodard-USGS)

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois
Zuehls, E. E.; Ryan, G. L.; Peart, D. B.; Fitzgerald, K. K.
Geological Survey, Urbana, IL. Water Resources Div.
Geological Survey Open-File Report 81-636 (WRI), September 1981. 66 p.,
Journal Announcement: SWRA1511
The eastern region of the Interior Coal Province has been divided into 11 hydrologic study areas. Area 25, located in west-central Illinois, includes the Spoon River and small tributaries to the Illinois River. Pennsylvanian age rocks underlie most of the study area. Illinois, with the largest reserves of bituminous coal, is second only to Montana in total coal reserves. Loess soils cover most of the study area. Agriculture is the dominant land use. Surface water provides 97% of all the water used. collected at over 31 sites. Analysis for specific conductance, pH, alkalinity, iron, manganese, sulfate and many trace elements and other water-quality constituents have been completed. These data are available from computer storage through the National Water Data Storage and Retrieval System (WATSTORE). (USGS)

Hydrology of area 35, Eastern Region, Interior Coal Province, Illinois and Kentucky
Zuehls, E. E., Ryan, G. L., Peart, D. B., and Fitzgerald, K. K., 1981
U.S. Geological Survey Water Resources Investigations Open-File Report 81-403, 68 p., (includes Shawnee National Forest area).

GEOLOGY FOR PLANNING IN ST. CLAIR COUNTY, ILLINOIS
ILLINOIS STATE GEOLOGICAL SURVEY, URBANA.
ILLINOIS STATE GEOLOGICAL SURVEY CIRCULAR 465, 1971. A. M. JACOBS COMPILER. 35 P, 4 FIG, 8 TAB, 63 REF.,
Journal Announcement: SWRA0619
ST. CLAIR COUNTY LIES IN SOUTHWESTERN ILLINOIS ACROSS THE

MISSISSIPPI RIVER FROM ST. LOUIS, MISSOURI. ONE-FIFTH OF THE TOTAL LAND SURFACE OF 673 SQUARE MILES IS ON FLOOD PLAINS OF THE MISSISSIPPI AND KASKASKIA RIVERS AND SILVER CREEK. THE FLOOD PLAINS ARE UNDERLAIN BY AS MUCH AS 120 FEET OF GRAVEL, SAND, SILT, AND CLAY. THE REMAINING FOUR-FIFTHS OF THE LAND SURFACE IS ON UPLANDS THAT CONTAIN FLAT OR DISSECTED PLAINS, LOW RIDGES AND MOUND-SHAPED HILLS, ABOUT 20 SQUARE MILES OF STRIP MINES, AND AN AREA OF KARST TOPOGRAPHY. MINERAL AND WATER RESOURCES ARE ABUNDANT IN THE COUNTY. WATER RESOURCES INCLUDE GROUNDWATER FROM NEAR-SURFACE UNCONSOLIDATED DEPOSITS AND FROM BEDROCK AND SURFACE WATER FROM THE MISSISSIPPI RIVER. IN SOME AREAS GEOLOGIC CONDITIONS IMPOSE LIMITATIONS ON THE USE OF LAND FOR PARTICULAR PROBLEMS PRECLUDE USE FOR THOSE PURPOSES. RARELY ARE THE LIMITATIONS SEVERE ENOUGH THAT THEY CANNOT BE OVERCOME BY AVAILABLE ENGINEERING AND CONSTRUCTION TECHNIQUES. THIS GEOLOGIC INFORMATION WAS PREPARED FOR LAND-USE AND RESOURCE PLANNING ON A COUNTY-WIDE SCALE. (WOODARD-USGS)

Water Resources Data for Illinois, published annually since 1975 River Basin

Geological Survey, Urbana, IL. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161.

Water resources data for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)

WATER RESOURCES INVESTIGATIONS IN ILLINOIS, 1977

GEOLOGICAL SURVEY, WASHINGTON, D.C.

GEOLOGICAL SURVEY REPORT OF INVESTIGATIONS FOLDER, 1 SHEET, 1977. 6 FIG, 1 MAP.,

Journal Announcement: SWRA0515

THE WATER RESOURCES STUDIES AND INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN ILLINOIS ARE SUMMARIZED. A SELECTED BIBLIOGRAPHY OF MATERIAL CONCERNING THE STATE IS INCLUDED. A LIST IS GIVEN OF STATE AND FEDERAL AGENCIES, COUNTIES, AND CITIES WHO COOPERATE IN DIFFERENT PARTS OF THE PROGRAM. THE HYDROLOGIC DATA NETWORK CONSISTS OF 173 PRIMARY, SECONDARY, AND WATER MANAGEMENT STREAMFLOW STATIONS; 4 GOUNDWATER OBSERVATION WELLS; AND 7 WATER QUALITY OBSERVING SITES. SMALL STATE MAPS

SHOW AVERAGE ANNUAL PRECIPITATION, DISCHARGE OF PRINCIPAL RIVERS, AND AREAS OF FLOOD INUNDATION. A MAP, SCALE 50 MI TO THE IN., SHOWS BY SYMBOLS, NUMBERS, AND COLORED OUTLINE THE HYDROLOGIC DATA NETWORK AND INVESTIGATIONS IN ILLINOIS IN JUNE 1968. (WOODARD-USGS)

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A water-quality assessment of the Anderson River watershed, Crawford, Dubois, Perry, and Spencer Counties, Indiana
Ayers, M. A., 1975
U.S. Geological Survey Open-File Report 75-325, 23 p.

A water-quality assessment of the Middle Fork Anderson River watershed, Crawford and Perry Counties, Indiana
Ayers, M. A., 1978
U.S. Geological Survey Open-File Report 78-71, 31 p.

A Water-Quality assessment of the Prairie Creek Watershed Vigo County, Indiana
Ayers, Mark A.
U.S. Geological Survey Open-File Report 75-515, 19 p.

A water-quality assessment of the Prairie Creek watershed was made April 1 to 5, 1974. Stream waters were a calcium bicarbonate type with moderately low dissolved solids content except where affected by drainage from coal mines in the headwaters. Dissolved manganese values were above the desired level of 0.05 milligram per litre at all but two sites sampled. Stream waters contained less than 0.05 milligram per litre dissolved phosphorus, and dissolved nitrate concentrations ranged from 0.8 to 2.9 milligrams per litre. Fecal coliform bacteria concentrations ranged from 150 to 3,500 colonies per 100 millilitres. Fecal streptococci concentrations ranged from 450 to 2,300 colonies per 100 millilitres. The concentration of dieldrin in bed materials increased in a downstream direction in Prairie Creek from about 2 to 6 micrograms per kilogram. About 15 micrograms per kilogram PCB compounds were found in an upstream sampling site and 2.3 micrograms per kilogram DDT were found in a downstream sampling site. The Prairie Creek benthic communities at two sites were 80 percent midge and black fly larvae, with diversity indices of 2.7 and 2.8.

Gazetteer of Coal-Mine Lakes in Southwestern Indiana
Bobo, L. L.
Geological Survey, Indianapolis, IN. Water Resources Div. report), June 1979. 107 p, 54 Fig, 2 Tab, 13 Ref.,
Journal Announcement: SWRA1303

This gazetteer is a catalog of lakes formed by surface coal mining in southwestern Indiana that are 0.5 acre or larger and in nonactive mine areas. Approximately 1,000 of the lakes are listed by 7.5-minute quadrangle topographic-map name, lake-identification number, latitude and longitude, and county. Other data given are shape of lake, maximum length, mean width, length and development of shoreline, surface area, orientation, presence of a stream inlet or outlet, and geologic data (geologic formation of area surrounding the lake and the mined coal-bed member). Field data (sampling date, pH, specific conductance, apparent color of lake, and general vegetation along the shoreline) were collected for 287 of the lakes. The apparent colors of the lakes observed were varying shades of aqua, blue, brown, lime green, red, and green. Eighty percent of the lakes sampled were green. (Woodard - USGS)

Ground and surface-water quality and hydrologic data from in and around an active surface coal-mine, Clay and Vigo Counties, Indiana

Bobo, L. L., and Eikenberry, S. E.,

U.S. Geological Survey.

Few data exist from reclaimed surface coal mines to evaluate water quality and hydrology, particularly in areas where high acid-production potential material is selectively buried. Because so few data exist from these regions, a study was done to determine the effects of modern mining and reclamation on both ground and surface water in and around an active reclaimed surface coal mine, Clay and Vigo Counties, Indiana.

From September 1977 through February 1980, water quality and hydrologic data were collected from 41 wells and 24 stream sites. Land use in the study area was: agricultural and forested, affected and unaffected by mining operations, and reclaimed and unreclaimed surface coal mine.

Field measurements included water temperature, specific conductance, pH, Eh, dissolved oxygen, ground-water elevations and streamflow. Water samples from wells and streams were analyzed for concentration of major cations and anions, alkalinity, hardness, aluminum, iron, manganese, trace elements, organic carbon, phosphorous and dissolved-solids residue at 180 degrees Celsius.

Ferrous iron concentrations were determined in water samples from selected wells, and percent sulfur by weight and potential acidity were determined in split-drive reclaimed-cast-overburden samples. Additional analyses of stream samples done to determine (1) concentrations of elements absorbed onto streambed materials, (2) concentrations and particle size of suspended-sediment water, and (3) populations and Shannon diversity indices of phytoplankton in water.

Water-Quality and other Hydrologic Data collected in and around a surface coal mine, Clay and Vigo Counties, Indiana, 1977-80

Bobo, Linda L., and Eikenberry, Stephen E.

U.S. Geological Survey Open-File Report 82-639, 117 p.

Few data are available for evaluating water-quality and other hydrologic properties in and around surface coal mines, particularly in areas where material having a high acid-production potential is selectively buried. This report contains hydrologic data collected in coal-mining areas in Clay and Vigo Counties, Indiana, from September 1977 through February 1980. Methods of sampling and analysis used in collecting data are also described.

The data include field and laboratory measurements of water at 41 wells and 24 stream sites. Variables measured in the field include water temperature, specific conductance, pH, Eh, dissolved oxygen, ground-water levels, and streamflow; and in the laboratory, concentrations of major ions, alkalinity, hardness, trace elements (in this report, elements having concentrations of 1 milligram per liter or less), organic carbon, phosphorus, and dissolved solids. Other variables measured in the laboratory include ferrous iron concentration of water samples from selected wells, percent sulfur by weight and the potential acidity of core samples of reclaimed cast overburden, concentrations of elements adsorbed on streambed materials, concentrations and particle size of suspended sediment in water, and populations and Shannon diversity indices of phytoplankton in water. Dissolved-solids concentrations and pH of ground water ranged from 173 to 5,130 milligrams per liter and from 6.1 to 8.9, respectively, and of surface water, from 120 to 4,100 milligrams per liter and from 6.1 to 8.8, respectively.

Evaluation of ground-water quality, coal mining region, southwestern Indiana. (Soon to be published).
Bobo, L. L., and Martin, J. D.

Water-Quality Assessment of the Cypress Creek Watershed, Warrick County, Indiana
Bobo, L. L.; Peters, C. A.
Geological Survey, Indianapolis, IN. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-221989, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-35, May 1980. 67 p, 17 Fig, 12 Tab, 34 Ref.,
Journal Announcement: SWRA1410
The U.S. Soil Conservation Service needs chemical, biological, microbiological, and hydrological data to prepare an environmental evaluation of the water quality in the Cypress Creek watershed, Warrick County, Ind., before plans can be devised to (1) improve water quality, (2) minimize flooding, (3) reduce sedimentation, and (4) provide adequate outlets for drainage in the watershed. The U.S. Geological Survey obtained these data for the Soil Conservation Service in a water-quality survey of the watershed from March to August 1979. Past and present surface coal mining is the factor having the greatest impact on water quality in the watershed. The upper reaches of Cypress Creek receive acid-mine drainage from a coal-mine waste slurry during periods of intense rainfall. All the remaining tributaries, except Summer Pecka ditch, drain mined or reclaimed lands. The general water type of Cypress Creek and most of its tributaries is calcium and magnesium sulfate. In contrast, the water type at background site 21 on Summer Pecka ditch is calcium sulfate. Specific conductance ranged from 470 to 4,730 micromhos per centimeter at 25 degrees Celsius, and pH ranged from 1.2 to 8.8. Specific conductance, hardness, and concentrations of major ions and dissolved solids were highest in tributaries affected by

mining. The pH was lowest in the same tributaries. Concentrations of iron, manganese, and sulfate in water samples and chlordane, DDT, and PCB's in streambed samples exceeded water-quality limits set by the U.S. Environmental Protection Agency. (USGS)

HYDROGEOLOGY OF THE PRINCIPAL AQUIFERS IN SULLIVAN AND GREENE COUNTIES, INDIANA

CABLE, L. W.; ROBISON, T. M.

GEOLOGICAL SURVEY, INDIANAPOLIS, IND.

INDIANA DEPARTMENT OF NATURAL RESOURCES DIVISION OF WATER BULLETIN NO 35, 1973. 26 P, 8 FIG, 3 PLATE, 4 TAB, 28 REF.,

Journal Announcement: SWRAU708

THE ROCKS THAT UNDERLIE SULLIVAN AND GREENE COUNTIES, INDIANA, MAY BE PLACED IN TWO GENERAL CATEGORIES--CONSOLIDATED AND UNCONSOLIDATED. BASED ON THEIR WATER-BEARING PROPERTIES THE CONSOLIDATED ROCKS ARE SUBDIVIDED INTO THREE MAJOR HYDROLOGIC UNITS. AQUIFERS IN UNIT 1 ARE RELATIVELY THICKBEDDED LIMESTONE AND SANDSTONE BODIES. THE AVERAGE YIELD FROM WELLS IN THIS UNIT IS 10 GPM WITH YIELDS OF AS MUCH AS 100 GPM REPORTED. THE AQUIFERS OF UNIT 2 ARE SANDSTONE BODIES WHICH OCCUR THROUGHOUT THE STRATA OF THIS UNIT. THE AVERAGE YIELD OF WELLS IN THIS UNIT IS 5 GPM, AND MAXIMUM YIELDS ARE ABOUT 20 GPM. UNIT 3 IS SIMILAR IN MOST RESPECTS TO UNIT 2; HOWEVER, IN THIS UNIT THERE ARE FEWER WATER-BEARING SANDSTONE BODIES AND, AS A CONSEQUENCE, AUMEROUS DRY HOLES ARE DRILLED. AQUIFERS IN THE UNCONSOLIDATED ROCKS OF THE REA ARE COARSE SAND AND GRAVEL DEPOSITS LOCATED PREDOMINANTLY ALONG THE STREAM VALLEYS. THE VALLEYS OF THE WABASH AND WHITE RIVERS CONTAIN THE THICKEST AND, THEREFORE, THE BEST UNCONSOLIDATED ROCK AQUIFERS. YIELDS FROM WELLS IN THESE AQUIFERS AVERAGE 350 GPM WITH YIELDS OF AS MUCH AS 1,000 GPM REPORTED. ANALYSES OF OVER 300 WATER SAMPLES INDICATE THAT THE CONSOLIDATED ROCKS OF THE AREA YIELD CALCIUM BICARBONATE, SODIUM BICARBONATE, AND SODIUM CHLORIDE WATER, AND THE UNCONSOLIDATED ROCKS YIELD CALCIUM BICARBONATE WATER. (WOODARD-SGUS)

Hydrogeology of the principal aquifers in Vigo and Clay Counties, Indiana

Cable, L. W., Watkins, F. A., Jr., and Robison, T. M., 1971

Indiana Division of Water Bulletin 34, 91 p.

Ground-Water Resources of Vanderburgh County, Indiana

Cable,L . W.; Wolf, R. J.

Geological Survey, Reston, Va. Water Resources Div.; and Geological Survey, St. Paul, Minn. Water Resources Div.

Indiana Department of Natural Resources, Indianapolis, Bulletin No 38 of the Division of Water, 1977. 37 p, 19 fig, 3 plates, 3 tab, 17 ref.,

Journal Announcement: SWRA1017

Sandstone units of Middle and Late Pennsylvanian age and sand

and gravel of Quaternary age are the source of fresh (1,000 parts per million of dissolved solids or less) ground water in Vanderburgh County, Indiana. Aquifers occur in older rocks, but, owing to their depth, the water is too highly mineralized to be useful for most purposes. Sand and gravel deposits of the Ohio River Valley are the best aquifer in Vanderburgh County. These deposits form a single hydrologic unit referred to as the Ohio River valley aquifer. This is the only aquifer in the county capable of accommodating high-yield wells. Properly constructed wells in this aquifer could easily yield 1,000 gallons per minute and more. Transmissibilities in the Ohio River valley aquifer range from 120,000 gallons per day per foot and less near the valley walls to more than 200,000 gallons per day per foot in the thickest parts of the aquifer. The water in the aquifer is predominately a very hard calcium bicarbonate type having a high iron content. (Woodard-USGS)

Analysis of historical surface-water-quality data in the coal mining region of southwestern Indiana. (Soon to be published).
Crawford, C. G.

A Water-Quality Assessment of the Feather Creek Watershed, Vermillion County, Indiana
Eikenberry, Stephen E.
U.S. Geological Survey Open-File Report 77-499, 21 p.

Chemical quality of surface water within the Feather Creek watershed is generally good. However, fecal bacteria concentrations are high enough to represent a potential problem, especially because of the water-contact recreation proposed for the future reservoir.

Chemical analyses of surface-water samples collected on October 9, 1974, and periodically from October 1, 1975, to September 28, 1976, show that the water was calcium bicarbonate type at all sites except one, where it was calcium sulfate. Range of dissolved-solids concentration was from 290 to 1,080 milligrams per liter.

Ranges of concentrations (in milligrams per liter) of some of the dissolved constituents in water were: nitrate (as nitrogen), from 0.01 to 6.9; phosphate (as phosphorus), from 0.01 to 0.14; and total organic carbon, from 2.5 to 16. Concentrations of fecal coliform bacteria and fecal streptococci bacteria ranged from 60 to 6,700 and 70 to 18,000 colonies per 100 milliliters, respectively.

Concentration of dieldrin in bed materials from two sites was 0.4 microgram per kilogram, but aldrin, chlordane, DDD, DDE, DDT, endrin, heptachlor, heptachlor epoxide, lindane, Toxaphene, polychlorinated biphenyl (PCB), and polychlorinated naphthalene (PCN) compounds were not detected.

NAVICULA sp and SCENEDESMUS sp dominated the phytoplankton community at the site sampled and indicated an environment lacking in organic enrichment. CLADOPHORA sp dominated the periphyton community sampled. Benthic invertebrates sampled were mostly caddis flies (CHEUMATOPSYCHE sp) and midges (ORTHOCLADIUS sp) and had a diversity index of 2.3, which indicates some organic enrichment of the stream.

A Water-Quality Assessment of the Busseron Creek Watershed, Sullivan, Vigo, Greene, and Clay Counties, Indiana
Eikenberry, S. E.
Geological Survey, Indianapolis, IN. Water Resources Div.
Open-file report 78-13, January 1978. 36 p, 7 fig, 6 tab, 21 ref.,
Journal Announcement: SWRA1113

Chemical quality of surface water in the 237-square mile Busseron Creek watershed, in Indiana, is significantly affected by drainage from coal mines and municipalities. Drainage from coal mines is primarily a problem of higher than normal dissolved-solids concentration, whereas, drainage from municipalities is generally a problem of bacteria and phytoplankton. Generally, the water is calcium bicarbonate type, except in streams affected by drainage from coal mines, where the water is a mixed calcium and magnesium sulfate type. Ranges of concentration (in milligrams per liter) of dissolved solids and of some of the chemical constituents dissolved in streams from September 1975 to July 1976 were: dissolved solids, from 104 to 2,610; iron, from 0.00 to 150; sulfate, from 14 to 1,900; chloride, from 3.3 to 130; nitrate (as nitroglen), from 0.01 to 5.3; phosphate (as phosphorus), from 0.1 to 1.7; and total organic carbon, from 2.4 to 60. Range of pH was from 2.7 to 9.6 Ranges of concentration of chlorinated hydrocarbons (in micrograms per kilogram) detected in bed material of streams were: aldrin, from 0.2 to 0.4; chlordane, from 0 to 13; DDE, from 0.0 to 0.3; dieldrin, from 0.0 to 9.8; and heptachlor epoxide, from 0 to 1.0. Streams draining municipalities had high populations of fecal coliform bacteria (as many as 46,000 colonies per 100 milliliter) and phytoplankton (as many as 190,000 cells per milliliter). Dissolved-oxygen concentration ranged from 2.8 to 15.0 milligrams per liter. (Woodard-USGS)

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana
Peters, J. G.
Geological Survey, Indianapolis, IN. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $8.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-543, June 1981. 61 p, 12 Fig, 15 Tab, 50 Ref.,
Journal Announcement: SWRA1501

The water quality in an unnamed tributary to Spencer Creek upstream and downstream from a surface mine and in South Lake adjacent to the mine were monitored during a 5-year study (1975-79) in the 1,210-acre watershed of the tributary. Compared with the background values, pH and concentrations of all major dissolved ions and dissolved, suspended, and streambed metals generally increased in Spencer Creek tributary downstream from the mine. Median dissolved-sodium and sulfate concentrations increased as much as eighteenfold and fourteenfold, respectively, and median dissolved-manganese and suspended aluminum concentrations increased as much as sevenfold and more than twofold. Concentrations of suspended metals decreased more than 50% after installation of sediment ponds by the mine operator. During high streamflow, concentrations of major ions at background and at mined sites on Spencer Creek tributary decreased, but dissolved- and suspended-metal concentrations increased downstream from the mine. South Lake exhibited seasonal stratification and mixing characteristics of other lakes at a similar latitude. However, the bottom 3 feet of the water column demonstrated persistent chemical stratification. Phytoplankton populations of the lake varied seasonally, and the population density patterns resembled those in other lakes at latitudes similar to that of South Lake. (USGS)

Geomorphology and quaternary geology of the Owensboro quadrangle, Indiana and Kentucky.
Ray, L. L., 1965
U.S. Geological Survey Professional Paper 488, 72 p.

Analysis of stormwater quality for different land uses in the coal-mining region of southwestern Indiana. (Soon to be published).
Renn, D. E.

Quality of Surface Water in the Coal-Mining Region, Southwestern Indiana, March and May 1979
Renn, D. E.; Ragone, S. E.; Wilber, W. G.
Geological Survey, Indianapolis, IN. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $8.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-970, September, 1980. 65 p, 24 Fig, 15 Tab, 7 Ref.,
Journal Announcement: SWRA1412

On August 3, 1977, the Surface Mine Control and Reclamation Act, Public Law 95-87 (the Act) was enacted by the 95th Congress. Under Section 507(b)(11) of the Act, an appropriate Federal or State agency must provide applicants for coal-mining permits hydrologic and water-quality information for the general use of proposed mining. To help meet the goals of the Act, the U.S. Geological Survey is designing a data-collection network in the coal-mining region of southwestern Indiana. The purpose of the network is to provide hydrologic and water-quality data on the 'general area' for coal-mining permits. Because of the large size of the study area and the lack of hydrologic and water-quality data, a preliminary assessment is being done to determine the factors that affect water quality in the coal-mining region. This information will be used in designing a data network that will (1) provide the hydrologic and water-quality data needed by applicants for coal-mining permits and (2) determine the major factors that affect water quality. Reconnaissance data were collected at 293 sites in March, and hydrologic and water-quality data were collected at 84 synoptic sampling sites in May. (Synoptic sampling is the virtually simultaneous collection of data at specific sites.) In the reconnaissance, pH, specific conductance, dissolved-oxygen concentration, temperature, and Eh of streams were measured on site to provide general water-quality data. In the synoptic sampling, the preceding characteristics, as well as concentrations of various dissolved and suspended constituents of stream water and concentrations of heavy metals on streambed materials, were determined. (USGS)

Quality of surface-water in the coal-mining region, southwestern Indiana, October 1979 to September 1980. (Soon to be published).
Renn, D. E., Wilber, W. G., and Crawford, C. G.

Ground-Water Resources of Posey County, Indiana
Robison, T. M.
Geological Survey, Mineola, NY. Water Resources Div.
Indiana Department of Natural Resources (Indianapolis), Bulletin No 39, 1977. 27 p, 6 fig, 4 plates, 2 tab, 18 ref.,
Journal Announcement: SWRA1111

Glacial sand and gravel deposits in and near the Wabash and Ohio River valleys of Posey County, Ind., are capable of yieling from 50 to more than 1,000 gallons per minute of water to individual wells. In the tributary valleys as much as 80 gallons per minute has been obtained from small, isolated sand and gravel deposits. In the remainder of the county, wells in sandstones of Pennsylvanian age yield from 5 to 25 gallons per minute. Natural discharge from sand and gravel into the Wabash and Ohio Rivers is estimated to be 40 million gallons per day, far exceeding the 6 million gallons per day estimated usage of ground water in the county. The shallow ground water is normally of the calcium bicarbonate type and has a dissolved-solids concentration of less than 500 parts per million. In deep bedrock wells, the water is of the sodium bicarbonate sodium chloride type and has a dissolved-solids concentration of more than 500 parts per million. (Woodard-USGS)

Low-Flow Characteristics of Indiana Streams

Stewart, James A.

U.S. Geological Survey Open-File Report82-1007, 277 p., 8 illus., 1 table

Knowledge of low-flow characteristics of Indiana streams is essential to the planners and developers of water resources for municipal, industrial, and recreational uses in the State. Low-flow frequency characteristics and points on the duration curve are given for 208 continuous-record gaging stations having 10 or more years of record. In addition, a few low-flow-frequency characteristics were estimated for each of 258 partial-record stations. Methods used for estimating these characteristics are included in the report.

A preliminary biological assessment of streams in the coal-mining region of southwestern Indiana. (Soon to be published).

Wangsness, D. J.

Reconnaissance of stream Biota and Physical and Chemical Water Quality in areas of selected land use in the coal mining region, southwestern Indiana, 1979-80

Wangsness, David J., 1982

U.S. Geological Survey Open-File Report 82-566, 43 p.

To help meet the goals of the Surface-Mining Control and Reclamation Act of 1977, the U.S. Geological Survey is assessing the physical, chemical, and biological characteristics of surface water within the coal-mining region of southwestern Indiana. This report discusses benthic-invertebrate and periphyticalgal communities in streams draining homogeneous--agricultural, forested, active/reclaimed-mine, reclaimed-mine, and unreclaimed-mine watersheds--and relates the biological communities to the physical and chemical characteristics of the streams.

Alkalinity and pH were lower and the concentrations of dissolved solids, suspended solids, calcium, magnesium, sodium, potassium, sulfate, iron, manganese, aluminum, and zinc were higher in unreclaimed-mine watersheds than in the other land-use watersheds.

Numbers and community diversity of benthic invertebrates were less at sites affected by mining than at agricultural or forested sites, owing to (1) synergistic effects of low pH, metals, and unsuitable habitat and (2) lack of colonizing drift organisms because of the small drainage area upstream from the mined area. Only a few organisms, such as the caddisflies CHEUMATOPSYCHE and HYDROPSYCHE and the chironomids CHIRONOMUS and CRICOTOPUS were found in streams draining mine areas.

Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana

Wangsness, D. J.; Eikenberry, S. E.; Wilber, W. G.; Crawford, C. G.

Geological Survey, Indianapolis, IN. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-408, March, 1981. 50 p, 12 Fig, 14 Tab, 42 Ref.,
Journal Announcement: SWRA1509

The White River Park Commission is planning the development of park facilities along the White River through Indianapolis, Ind. A key element in the planning is the determination of whether water quality of the river is suitable for recreation. A preliminary water-quality assessment conducted August 4-5, 1980, indicated that, during low-flow steady-state conditions, the river is suitable for partial body contact recreation (any contact with water up to, but not including complete submergence). Dissolved-oxygen concentrations varied but were higher than the Indiana water-quality standards established to ensure conditions for the maintenance of a well-balanced, warm-water fish community. High fecal-coliform densities that have been observed in the White River during high streamflow are probably caused by stormwater runoff carried by combined storm and sanitary sewers. However, during the low-flow, steady-state conditions on August 4-5, 1980, fecal-coliform densities were within the Indiana standards for partial body contact recreation. Quantities of organic matter and concentrations of nutrients and heavy metals in the White River were generally within the limits recommended by the U.S. Environmental Protection Agency and were generally similar to values for other Indiana rivers. Chromium, copper, lead, zinc, and mercury are accumulating in bottom materials downstream from 30th Street. The phytoplankton concentrations in the White River were high. The dominant phytoplankton species were indicative of rivers moderately affected by organic wastes. (USGS)

Hydrology of Area 30, Eastern Region, Interior Coal Province, south- western Indiana. (Soon to be published).
Wangsness, D. J., MacKenzie, A. L., Miller, R. L., Bailey, Z. Chapman, and Arijood, L. D.

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana
Wangsness, D. J.; Miller, R. L.; Bailey, Z. C.; Crawford, C.
Geological Survey, Indianapolis, IN. Water Resources Div.
Geological Survey Open-File Report 81-498 (WRI), August 1981. 76 p, 38 Fig, 12 Tab, 56 Ref, Append.,
Journal Announcement: SWRA1511

Hydrologic and water-quality information from the coal region in parts of 11 counties in southwestern Indiana are summarized. Pennsylvanian and Mississippian bedrock are overlain by drift and till from the Kansan, Illinoian, and

Wisconsinan glaciers that covered two-thirds of the area. Most of the coal is mined from Pennsylvanian coal units. As of 1978, more than 1-billion short tons of coal had been mined from the 11 counties. More than 12-billion short tons remained in reserve. During 1978, 17.8-million short tons were mined. Coal mining disturbs less than 1% of the land in the study area. Sixty-two percent of the land use is agricultural, and 29% is forested. More coal is mined in the southern and western parts of the study area than elsewhere. Surface water in these parts had lower pH and alkalinity than water in the north and east parts. Specific conductance and concentrations of sulfate, iron, and manganese in surface water were higher in the south and west than elsewhere. (USGS)

Hydrologic assessment of Area 33, eastern region, Interior Coal Province, southwestern Indiana and northern Kentucky. (Soon to be published).
Wangsness, D. J., and others
U.S. Geological Survey Water-Resources Investigations Open-File Report 81-423.

Ground-water resources of west-central Indiana, preliminary report-Vigo County
Watkins, F. A., Jr., and Jordan, D. G., 1963
Indiana Division of Water Bulletin 17, 286 p.

Ground-water resources of west-central Indiana, preliminary report-Vermillion County
Watkins, F. A., Jr., and Jordan, D. G., 1965
Indiana Division of Water Bulletin 29, 90 p.

GROUNDWATER APPRAISAL OF THE BIG WALNUT CREEK BASIN ABOVE LITTLE WALNUT CREEK AND BIG WALNUT CREEK RESERVOIR SITE, INDIANA
WATKINS, FRANK A. JR
GEOLOGICAL SURVEY, WASHINGTON, D.C.
US 90TH CONGR, 2ND SESS, SENATE DOC 96, VOL 2, APPEND J, P 278-288, 1968. 11 P, 4 FIG, 1 TAB.,
Journal Announcement: SWRA0223
LOSS OF WATER FROM A PROPOSED RESERVOIR IS POSSIBLE WHERE THE CHANNEL OF BIG WALNUT CREEK, INDIANA IS CUT INTO BEDROCK IN THE POOL AREA. DURING DRY-WEATHER PERIODS THE CREEK LOSES WATER IN THIS REACH. WATER SUPPLY IS NOT A PROBLEM IN THE BASIN AT THE PRESENT TIME BUT COULD BECOME A PROBLEM IN THE GREENCASTLE AREA IN A PERIOD OF SEVERE DROUGHT. (KNAPP-USGS)

Reconnaissance for determining effects of land use and surficial geology on concentrations of selected elements on streambed materials from the coal-mining region, southwestern Indiana, October 1979 to March 1980
Wilber, William G., and Boje, Rita R.
U.S. Geological Survey Water-Resources Investigations 82-4013,

39 p.

Streambed materials were collected from 69 sampling sites in areas of predominantly forested, agricultural, and reclaimed and unreclaimed mined land in the glaciated and unglaciated parts of southwestern Indiana to determine whether concentrations of sorbed metals and other trace elements were affected by land use and surficial geology.

Streambed materials smaller than 0.062 millimeter were collected in October 1979 and analyzed for sorbed and acid-soluble metals including aluminum, cadmium, chromium, copper, cobalt, iron, lead, manganese, mercury, nickel and zinc and several nonmetals, total arsenic, boron, and selenium.

Analysis of variance indicated that differences in land use accounted for 10 percent or more of the variation in aluminum, arsenic, cobalt, iron, nickel, selenium, and zinc concentrations on streambed materials. Differences in glacial province (surficial geology) did not significantly affect the concentrations of metals and other trace elements on streambed materials. Concentrations of aluminum, cobalt, iron, nickel, selenium, and zinc on the less than 0.062-millimeter fraction of streambed materials from mined watersheds were significantly greater than the concentrations of these elements on streambed materials from agricultural and forested watersheds. The greater concentrations of these elements are due to (1) their concentrations in mine drainage and their subsequent adsorption and (or) coprecipitation with the oxides and hydroxides of aluminum and iron and (2) their concentrations in coal and pyritic material in streambed materials.

Concentrations of aluminum and iron on streambed materials from reclaimed, mined watersheds were significantly less than the concentrations of these metals on streambed materials from unreclaimed, mined watersheds.

Preliminary assessment of the factors affecting water quality in the coal-mining region, southwestern Indiana, March to October 1979. (Soon to be published).

Wilber, W. G., Crawford, C. G., Renn, D. E., Ragone, S. E., and Wangness, D. J.

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana

Zogorski, J. S.; Ramey, D. S.; Lambert, P. W.; Martin, J. D.; Warner, R. E.

Geological Survey, Indianapolis, IN. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed Ctr, Denver, CO 80225, Price: $19.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-1107, October, 1981. 133 p, 34 Fig, 26 Tab, 32 Ref.,

Journal Announcement: SWRA1506

Protecting the nation's water resources is a major emphasis of the Surface Mining Control and Relclamation Act, PL 95-87. Permanent regulations established for this Act by the Office of Surface Mining (OSM) require the issuance of a permit before mining begins. An application for a mining permit must include an assessment of the hydrologic characteristics of the mining site and adjacent area, and a projection of the potential impacts of mining activities on surface water and ground water. OSM's permanent regulations and guidelines provide little insight on the 'how to' aspect of making the required hydrologic assessment. This investigation was completed to improve the understanding of the kinds of information needed to make such assessments by: (a) reviewing the regulations to determine what hydrologic information is required; (b) preparing an example hydrologic assessment using the regulations as a guideline; and (c) using the experience gained in (a) and (b) to identify areas lacking or needing additional data to make the required assessment. Hydrologic data for the study area were obtained from published and unpublished reports, maps, aerial photographs, personal interviews with residents in the area of the hypothetical mine site, and discussions with experts in the field. Where data were unavailable, 'synthetic' data were generated by extrapolation from proximate or similar watersheds and (or) by assumptions based on experience or theory. A limited amount of field data was collected to corroborate and augment information originating from all these sources. (USGS)

Water Resources Data for Indiana, Published annually since 1975.

Geological Survey, Indianapolis, IN. Water Resources Div.

Water resources data for Indiana consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells.

Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Indiana. (USGS)

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Availability of groundwater in Wayne County, Iowa
Cagle, J. W.
Geological Survey, Iowa City, Iowa.
Iowa Geological Survey Water Atlas No 3, 1969. 33 p, 10 Fig, 6 Tab.,
Journal Announcement: SWRA0310

Information is presented on the availability and quality of groundwater in Wayne County, one of several counties in Southern Iowa affected by a shortage of good-quality water. Only locally and in limited areas, or only after extensive water-quality treatment, are suitable supplies of groundwater available to satisfy the water needs. Bedrock aquifers yield variable small amounts of moderately to highly mineralized water. Surficial aquifers comprising glacial drift and alluvium are estimated to yield up to 45 gpm in some areas; an availability map indicates the areas where water supplies can be developed. Dissolved-solids concentrations range from about 470 mg/l in the alluvium to over 3,600 mg/l in the deep (more than 100 feet) Glacial drift. Many shallow (100 feet or less) supplies presently in use contain high concentrations of nitrate and chloride, and these concentrations are attributed to localized contamination. Wells in the alluvium and shallow drift that are properly constructed and located are expected to yield satisfactory quality water. (Knapp-USGS)

Definition and hydrology of the sandstone aquifers in the coal-bearing Pennsylvania strta of southcentral Iowa
Cagle, J. W., 1979,
Unpublished data on file in Iowa City Office of U. S. Geological Survey

Water Resources of South-Central Iowa
Cagle, J. W.; Heinitz, A. J. W.;
Geological Survey, Iowa City, IA, Water Resources Div.
Iowa Geological Survey Water Atlas No. 5, 1978. 97 p, 59fig, 14 tab, 36 ref.
Journal Announcement: SWRA1212

Information is presented on the availability, quality, and use of ground and surface water in an eleven-county area in south-central Iowa. The best sources of water supply in the area are Red Rock and Rathbun Lakes and other impoundments. The Des Moines River is the only stream in the area that can supply adequate amounts of water without storage. Yields of as wells from the deeply-buried Cambrian-Ordovician aquifer. Yields of 150 to Des Moines and Skunk Rivers; yields from the alluvium in tributary valleys is suitable for most purposes; dissolved solids generally are less than 500 is available from parts of all aquifers except the Devonian but only the gallons per day in 1972-73; ground water accounted for 66 percent of the total withdrawals and surface water sources made up

34 percent. (Woodard-USGS)

AVAILABILITY OF GROUNDWATER IN DECATUR COUNTY, IOWA
CAGLE, J. W.; STEINHILBER, W. L.
GEOLOGICAL SURVEY, IOWA CITY, IOWA.
IOWA GEOLOGICAL SURVEY WATER ATLAS NO 2, 1967. 27 P, 9 FIG, 3 TAB.,
Journal Announcement: SWRA0412

GROUNDWATER INFORMATION IS PRESENTED TO HELP SOLVE THE SUPPLY PROBLEMS OF SOME WATER USERS IN DECATUR COUNTY, IOWA. THE INFORMATION INCLUDES THE LOCATION, DEFINITION, AND ESTIMATED POTENTIAL YIELDS OF THE WATER-BEARING MATERIALS IN THE UNCONSOLIDATED DEPOSITS AND THE UPPERMOST BEDROCK; AN EVALUATION OF THE GENERAL OCCURRENCE AND AVAILABILITY OF WATER FROM BEDROCK GROUNDWATER SOURCES. DECATUR COUNTY HAS AN AREA OF 530 SQ MI AND, ACCORDING TO THE 1960 CENSUS, HAS A POPULATION OF 10,539. ABOUT 55% OF THE POPULATION LIVE ON FARMS OR IN SMALL COMMUNITIES WHERE THE WATER SUPPLY IS OBTAINED FROM PRIVATE WELLS, PONDS AND CISTERNS. THE REMAINDER OF THE RESIDENTS LIVE IN TOWNS THAT HAVE MUNICIPAL WATER SYSTEMS. SMALL-TO-MODERATE SUPPLIES OF WATER ARE AVAILABLE FOR DEVELOPMENT FROM THE UNCONSOLIDATED DEPOSITS IN THE COUNTY. YIELDS OF SEVERAL HUNDRED GPM PER WELL CAN BE OBTAINED FROM THE DEEPER BEDROCK STRATA AT ABOUT 2,600 TO 2,700 FEET IN DEPTH. BEDROCK STRATA (WOODARD-USGS)

MISSISSIPPIAN AQUIFER OF IOWA
HORICK, P. J.
GEOLOGICAL SURVEY, IOWA CITY, IOWA.
IOWA GEOLOGICAL SURVEY MISCELLANEOUS MAP SERIES 3, 1973. 3 SHEETS, 13 FIG, 4 TAB, 3 MAP, 10 REF.,
Journal Announcement: SWRA0709

THE PURPOSE OF THIS 3-SHEET ATLAS IS TO PRESENT INFORMATION ON THE OCCURRENCE, MOVEMENT, AVAILABILITY, USE, AND CHEMICAL QUALITY OF WATER FROM THE MISSISSIPPIAN AQUIFER IN IOWA. INCLUDED IS A BRIEF DESCRIPTION OF THE PHYSICAL CHARACTERISTICS AND SPATIAL RELATIONS OF THE ROCKS THAT CONTAIN THE WATER. ALSO DISCUSSED AND EVALUATED ARE THE AREAS OF HIGH POLLUTION HAZARD TO THIS AND UNDERLYING AQUIFERS. THE MISSISSIPPIAN AQUIFER UNDERLIES ABOUT 60% OF THE STATE, BUT IN ONLY ABOUT 15% OF THIS AREA CAN THE AQUIFER BE CONSIDERED A MAJOR SOURCE OF POTABLE WATER. THIS AREA COMPRISES ALL OR PARTS OF 10 COUNTIES IN THE NORTH-CENTRAL PART OF THE MISSISSIPPIAN OUTCROP, WHERE THE AQUIFER WILL YIELD MODERATE TO LARGE SUPPLIES OF GOOD TO EXCELLENT QUALITY WATER TO WELLS. ESTIMATES OF RECHARGE AND STORAGE IN THAT REGION INDICATE THAT MANY TIMES THE CURRENT WITHDRAWAL RATE OF ABOUT 12 MGD CAN BE DEVELOPED FROM THE AQUIFER. ELSEWHERE, THE AQUIFER YIELDS EITHER SMALL QUANTITIES OF MODERATELY TO HIGHLY MINERALIZED WATER (SUBCROP AREA), OR SMALL TO MODERATE QUANTITIES OF FAIR TO GOOD QUALITY WATER (SOUTHEAST OUTCROP AREA). ADDITIONAL SUPPLIES

PROBABLY CAN BE DEVELOPED IN BOTH AREAS. POTENTIAL CONTAMINATION HAZARD TO THE UNDERLYING CAMBRIAN-ORDOVICIAN AQUIFER EXISTS IN THE SUBCROP AREA OF THE MISSISSIPPIAN AQUIFER. IN THAT (KNAPP-USGS)

Jordan Aquifer of Iowa
Horick, P. J.; Steinhilber, W. L.
Geological Survey, Iowa City, IA.
Miscellaneous Map Series 6, 1978. 20 ref, 3 maps.,
Journal Announcement: SWRA1216

The purpose of this atlas was (1) to define and describe the spatial relations and physical characteristics of the Jordan aquifer, (2) to present information on the occurrence availability, use, and chemical quality of water in the aquifer, and (3) to define and delineate changes in the potentiometric surface of the aquifer. The geohydrologic information was divided into 3 subject headings that were presented on separate atlas sheets--geology, hydrology, and chemical quality. The Jordan aquifer is the most productive water-yielding unit of the Cambrian-Ordovician aquifer system, and is one of the most dependable sources of water supply for large capacity wells in Iowa. The total thickness of the aquifer ranges from about 400 to 450 feet in east-central and southeastern Iowa to about 150 feet or less in western Iowa. The transmissivity of the aquifer is

Baseline Water Quality of Iowa's Coal Region
Slack, L. J.
Geological Survey, Iowa City, IA. Water Resources Div.
Geological Survey open-file report 79-980, 1979. 74 p, 1 Fig, 7 Tab, 7 Ref.,
Journal Announcement: SWRA1303

To assist the Iowa Department of Environmental Quality in determining the effects that coal mining and attendant activities will have on the water quality of Iowa streams, the U.S. Geological Survey collected three sets of water-quality samples (representative of high, average, and low streamflow) in the White Breast, English,aand Cedar Creek basins in south-central Iowa. These samples were analyzed by the U.S. Geological Survey Central Laboratory at Denver, Colorado, and by the Iowa State Hygienic Laboratory (Iowa City and Des Moines). The report presents the data collected from May to November 1978 at 15 stations in the study area. (Woodard-USGS)

WATER RESOURCES DATA FOR IOWA, published annually since 1976.
GEOLOGICAL SURVEY, IOWA CITY, IOWA.
AVAILABLE FROM THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA 22161

WATER RESOURCES DATA FOR IOWA CONSISTS OF RECORDS OF STAGE, DISCHARGE, AND WATER QUALITY OF STREAMS; STAGE, CONTENTS AND

WATER QUALITY OF LAKES AND RESERVOIRS; AND WATER LEVELS IN WELLS.

THESE DATA REPRESENT THAT PART OF THE NATIONAL WATER DATA SYSTEM OPERATED BY THE U.S. GEOLOGICAL SURVEY AND COOPERATING STATE AND FEDERAL AGENCIES IN IOWA. (WOODARD-USGS)

WATER RESOURCES INVESTIGATIONS IN IOWA, 1968

GEOLOGICAL SURVEY, WASHINGTON, D.C. SURVEY REPORT OF INVESTIGATIONS FOLDER, 1 SHEET, 1969. 4 FIG, 1 MAP.,

Journal Announcement: SWRA0516

WATER RESOURCES STUDIES AND INVESTIGATIONS OF THE U. S. GEOLOGICAL SURVEY IN IOWA ARE SUMMARIZED. A SELECTED BIBLIOGRAPHY OF MATERIAL CONCERNING THE STATE IS INCLUDED. A LIST IS GIVEN OF STATE AND FEDERAL AGENCIES, COUNTIES, AND CITIES WHO COOPERATE IN DIFFERENT PARTS OF THE PROGRAM. THE HYDROLOGIC QUALITY OBSERVING SITES. SMALL STATE MAPS SHOW PRINCIPAL SOURCES OF GROUNDWATER, NORMAL ANNUAL PRECIPITATION, AVERAGE ANNUAL RUNOFF, AND DISCHARGE OF THE PRINCIPAL RIVERS. A MAP, SCALE 30 MI TO THE INCH, SHOWS BY SYMBOLS, NUMBERS, AND COLORED OUTLINE THE HYDROLOGIC DATA NETWORK AND INVESTIGATIONS IN IOWA IN OCTOBER 1968. (WOODARD-USGS)

GEOHYDROLOGY OF DONIPHAN COUNTY, NORTHEASTERN KANSAS
BAYNE, C. K.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
FOR SALE BY USGS, WASHINGTON, D.C. 20242, PRICE $0.75. HYDROLOGIC INVESTIGATIONS ATLAS HA-462, 1973. 1 SHEET, 1 FIG, 6 MAP, 1 TAB, 13 REF.,
Journal Announcement: SWRA0701

THIS ONE-SHEET ATLAS DESCRIBES THE GROUNDWATER RESOURCES OF DONIPHAN COUNTY, THE NORTHEASTERN MOST COUNTY IN KANSAS. REPORTS DESCRIBING THE WATER RESOURCES OF THE AREA CONTIGUOUS TO DONIPHAN COUNTY ARE LISTED IN THE SELECTED REFERENCES. THE LOCATIONS OF WELLS AND TEST HOLES ARE IDENTIFIED ACCORDING TO THE FEDERAL SYSTEM OF LAND SUBDIVISION SHOWN BY A WELL-NUMBERING SYSTEM DIAGRAM. ADEQUATE SUPPLIES OF WATER FOR DOMESTIC AND STOCK USE GENERALLY ARE AVAILABLE FROM WELLS IN THE GLACIAL DEPOSITS UNDERLYING THE UPLAND AREAS OF DAONIPHAN COUNTY. ADJACENT TO THE MAJOR STREAMS, THE ALACIAL DEPOSITS ARE THEN OR HAVE BEEN REMOVED BY EROSION. IN THESE LOCALIZED AREAS, SMALL SUPPLIES OF WATER ARE AVAILABLE FROM WELLS DRILLED INTO BEDROCK AQUIFERS. LARGE SUPPLIES OF WATER ARE AVAILABLE ONLY FROM WELLS IN ALLUVIAL DEPOSITS IN THE MISSOURI RIVER VALLEY. THE GROUNDWATER IS HARD OR VERY HARD BUT MAY BE RENDERED SOFT BY SIMPLE TREATMENT. WATER FROM WELLS IN THE MISSOURI RIVER VALLEY AND IN SOME TRIBUTARY VALLEYS IS VERY HIGH IN IRON CONTENT. WATER CONTAINING EXCESSIVE AMOUNTS OF NITRATE OCCURS LOCALLY IN ALL THE AQUIFERS. (WOODARD-USGS)

Geology and Ground-Water Resources of Brown County, Kansas
Bayne, Charles K., and Schoewe, Walter H.
U.S. Geological Survey Bulletin 186.

Ground-water Resources of Elk County in Geology, mineral resources, and ground-water resources of Elk County, Kansas
Bayne, C. K., 1958
Kansas Geological Survey Report, v. 14, pt. 3, p. 37-55.

GEOHYDROLOGY OF DONIPHAN COUNTY, NORTHEASTERN KANSAS
BAYNE, CHARLES K.
KANSAS STATE GEOLOGICAL SURVEY, LAWRENCE.
GEOLOGICAL SURVEY OPEN-FILE REPORT, 1971. 21 P, 7 FIG, 2 PLATE, 1 TAB, 13 REF.,
Journal Announcement: SWRA0423

DATA CONCERNING GROUNDWATER RESOURCES IN DONIPHAN COUNTY, KANSAS ARE PRESENTED. ADEQUATE SUPPLIES OF WATER FOR DOMESTIC AND STOCK USE GENERALLY ARE AVAILABLE FROM WELLS IN THE GLACIAL DEPOSITS UNDERLYING THE UPLAND AREAS OF DONIPHAN COUNTY. ADJACENT TO THE MAJOR STREAMS, THE GLACIAL DEPOSITS ARE THIN OR HAVE BEEN REMOVED BY EROSION. IN THESE LOCALIZED

AREAS, SMALL SUPPLIES OF WATER ARE AVAILABLE FROM WELLS DRILLED INTO BEDROCK AQUIFERS. LARGE SUPPLIES OF WATER ARE AVAILABLE ONLY FROM WELLS IN ALLUVIAL DEPOSITS IN THE MISSOURI RIVER VALLEY. GROUNDWATER IN DONIPHAN COUNTY IS OF THE CALCIUM BICARBONATE TYPE. THE CONCENTRATION OF DISSOLVED OF INDIVIDUAL MINERAL CONSTITUENTS WERE BELOW THE U.S. PUBLIC HEALTH SERVICE RECOMMENDED MAXIMUM, EXCEPT THOSE FOR NITRATE AND IRON, WHICH IN RESPECTIVELY. (WOODARD-USGS)

Statistical summaries of water-quality data for streams draining coal-mined areas, southeastern Kansas

Bevans, H. E., and Diaz, A. M., 1980

U.S. Geological Survey Hydrologic Data, Open-File Report 80-350, 42 p.

A Procedure for Predicting Concentrations of Dissolved Solids and Sulfate Ion in Streams Draining Areas Strip Mined for Coal

Bevans, H. E.

Geological Survey, Lawrence, KS. Water Resources Div.

Geological Survey Open-File Report 80-764 (WRI), August, 1980. 17 p, 8 Fig, 2 Tab, 14 Ref.,

Journal Announcement: SWRA1424

Current trends in increased coal production necessitate the development of techniques to appraise the environmental degradation resulting from strip mining. A procedure is introduced for the prediction of dissolved-solids and sulfate-ion concentrations in streams draining strip-mined areas. Concentrations are a function of the percentage of the drainage area that has been strip mined. These relationships are expressed by regression equations computed from data collected in streams draining strip-mined areas of Cherokee and Crawford Counties in southeast Kansas. High correlation coefficients indicate that the relationships may be useful in the evaluation of present or future strip-mining operations. (USGS)

Description of Data-Collection System and Synopsis of Selected Hydrologic Data for Soldier Creek Basin, Kansas

Carswell, W. J. Jr

Geological Survey, Lawrence, KS. Water Resources Div.

Open-file report 78-678, July 1978. 80 p, 32 fig, 5 tab, 8 ref, 2 append. ,

Journal Announcement: SWRA1207

Soldier Creek basin is a long, narrow basin encompassing an area of about 290 square miles almost directly north of Topeka, Kansas. A wide range of hydrologic data has been collected in the basin since the spring of 1964. These data include rainfall, stream discharge, sediment concentrations, chemical quality of water, and ground-water altitudes. The data collection system consists of 7 recording streamflow stations, 5 recording rainfall stations, 51 nonrecording rainfall stations, and 31 ground-water observation wells. Sediment and chemical quality of water samples were collected intermittently at selected sites. A synopsis of the time and space distribution of rainfall and peak flow are provided in graphic and tabular form for selected events of rainfal and peak flow. Representative data concerning the chemical quality of water and the fluvial sediment also are included. Selected ground-water and seepage-investigation data are depicted graphicaly. (Woodard-USGS)

Hydrologic Data for Soldier Creek Basin, Kansas
Carswell, W. J. Jr
Geological Survey, Lawrence, KS. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-288 740, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-87, July 1978. 26 p, 1 fig, 1 tab, 6 ref.,

Journal Announcement: SWRA1209

Selected hydrologic data collected in the Soldier Creek basin in northeastern Kansas are available on magnetic tape in card-image format. Data on the tape include water discharge in fifteen-minute and daily time intervals; rainfall in fifteen-minute and daily time intervals; concentrations and particle sizes of suspended sediment; particle sizes of bed material; ground-water levels; and chemical quality of water in concentrations of selected constituents. The data-collection system includes: (1) 7 recording streamflow stations; (2) 5 recording rainfall stations; (3) 51 nonrecording rainfall stations located within and adjacent to the basin; (4) 31 ground-water observation wells (two recording); and (5) intermittent chemical quality of water and sediment sampling sites. Examples of the information on magnetic tape for each type of data collected are presented in computer-printout format. (Woodard-USGS)

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas
Carswell, W. J. Jr
Geological Survey, Lawrence, KS. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-138751, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-8, 1981. 68 p, 36 Fig, 7 Tab, 21 Ref.,

Journal Announcement: SWRA1510

Hydrologic data from Soldier Creek basin, northeastern Kansas, were compared with relations from statewide data. The quantity and quality of streamflow were affected mostly by soils, slopes, and land use. Average annual precipitation during the study (1964-76) was 35.12 inches, or 2.3 percent greater than the long-term (1929-76) average. The average streamflow in Soldier Creek at Topeka was 23 percent greater than the long-term average. In general, frequency curves of annual peak discharges compared poorly with curves from statewide relations due to the absence of extremely low peaks during the short period. A comparison of low-flow frequency for drainage areas of more than 100 square miles suggests that reasonable results may be obtained by extrapolating the statewide relations to small basins. Comparisons of flow-duration curves confirms the extrapolation for basins of less than 100 square miles, although the percentage duration of mean flow is variable. Water surveys showed that calcium, bicarbonate, and sulfate were the predominant ions and dissolved solids were derived mostly from limestones and shales. Suspended sediment at gaged sites ranged from 9.84 to 848 tons per days; yield per unit area increased significantly between two sites due to changes in slopes and land use. (USGS)

Multiyear Low Flow in Southeastern Kansas
Carswell, William J. Jr.
U.S. Geological Survey Water-Resources Investigations Open-File Report 79-1288.

Many existing water supplies in southeastern Kansas are proving inadequate to meet current and expanded future needs. One of the methods in which the use of highly variable streamflow in the area can be evaluated is with the aid of multiyear low-flow frequency information. Data from 19 stream-gaging stations in the study area and a base period of 1940-77 were used to develop maps from which discharge values for the 2- and 50-year recurrence interval for durations of 12, 24, 36, and 60 months can be obtained for ungaged sites that have drainage areas of less than 1,000 square miles. Discharge values for intervening recurrence intervals can be obtained by interpolation. Extrapolation of regionalized values in this report to drainage areas smaller than 110 square miles and larger than 1,000 square miles has not been validated.

A General Classification of Source Area's of Fluvial Sediment in Kansas
Collins, Dannie L.
U.S. Geological Survey Bulletin Number 8.

A map showing the mean annual sediment yields of large subdivisions of Kansas has been compiled by synthesizing the available data on areas geology, topography, soil characteristics, precipitation, runoff, sedimentation in reservoirs, and measured suspended-sediment loads of streams. The mean annual sediment yield, in tons per square mile, is less than 50 in parts of southwestern and south-central Kansas and is more than 5,000 in the extreme north-eastern part. The intermediate values characterizing the remainder of the state tend to increase from west to east.

Ground Water in the Verdigris River Basin, Kansas and Oklahoma
Fader, Stuart W., and Morton, Robert B.
U.S. Geological Survey Open-File Report 75-365

Magnitude and Frequency of Low Flows of Unregulated Streams in Kansas, and Estimation of Flow-Duration Curves for Ungaged Sites.
Jordon, P. R.
U.S. Geological Survey Technical Report No. 17.

Information on low-flow magnitude and frequency and on flow-duration characteristics is needed for evaluation of streams for such aspects as maintenance of aquatic life, water supplies, and pollution control. Low-flow information given in this report is for streamflow unaffected by major regulation, such as by large reservoirs. Low-flow magnitude and frequency data are given for 87 continuous-record streamflow-gaging stations throughout Kansas. Accuracy of the magnitude-frequency values is influenced greatly by the variability of the flow, but values shown as zero flow are very reliable. Percentage errors are largest for small rates of flow, which also are easily changed by manmade influences.

Seven-day low-flow values are provided for 76 partial-record stations and have been estimated from the relations to concurrent flows at nearby continuous-record stations. Estimation of low-flow magnitude and frequency at ungaged sites is unfeasible except near a gaging station on the same stream or after measurements have been made over a wide range of low flows.

Flow-duration curves for ungaged sites can be estimated by using a set of maps and graphs showing regionalized characteristics of such curves and their relations to size of drainage area. The low-flow part of an estimated flow-duration curve can be improved by the use of miscellaneous low-flow measurements.

Magnitude and Frequency of Floods in Kansas 1975
Jordan, P. R., and Irza, T. J.
Kansas State Water Resources Board Technical Report No. 11

Flood magnitudes for selected recurrence intervals for unregulated streams in Kansas were found to be related most significantly to the contributing drainage area and the 2-year 24-hour rainfall. Equations are provided for estimating flood peaks for selected recurrence intervals at ungaged sites or at gaging stations having short records. The accuracy of 100-year floods calculated from the equation is equivalent to the accuracy that would be obtained from about 12 years of record of flood peaks at the site.

Floods are most common from May through August in western Kansas and from April through July in eastern Kansas. Maximum known floods of an envelope curve for western Kansas range from 2,440 cubic feet per second for 1.6 square miles to 178,000 cubic feet per second for 6,770 square miles. Maximum known floods on an envelope curve for eastern Kansas range from 7,080 cubic feet per second for 2.06 square miles to 436,000 cubic feet per second for 3,818 square miles.

Geology and Ground-Water Resources of Neocho County, Kansas
Jungmann, William L.
U.S. Geological Survey Bulletin 183.

GEOLOGY AND GROUND WATER IN LABETTE COUNTY, KANSAS
JUNGMANN, WILLIAM L.; WILLIAMS, CHARLES C.
US GEOLOGICAL SURVEY.
US GEOL SURVEY HYDROL INV ATLAS HA-279, 1 P, 1968. 1 MAP, 2 TAB, DISC.,
Journal Announcement: SWRA6801

THE ATLAS DESCRIBES THE AVAILABILITY OF GROUND AND SURFACE WATER IN A COUNTY IN SOUTHEASTERN KANSAS. CONSOLIDATED BEDROCK AQUIFERS GENERALLY CONTAIN FAIR TO POOR QUALITY WATER AT SHALLOW DEPTHS. MOST WELLS YIELD LESS THAN 5 GPM, BUT SOME YIELD AS MUCH AS 40 GPM. WELLS DRILLED MORE THAN 1400 FT INTO CAMBRIAN AND ORDOVICIAN ROCKS HAVE YIELDED HIGHLY MINERALIZED WATER. UNCONSOLIDATED ALLUVIAL DEPOSITS ALONG THE NEOSHO RIVER AND OTHER STREAMS ARE THE BEST AQUIFERS. GROUPS OF WELLS OR COLLECTION GALLERIES IN THESE DEPOSITS MAY PRODUCE 100 GPM. AN AQUIFER TEST IN A WELL IN ALLUVIAL RIVER AT PARSONS IS ABOUT 2,400 CFS AND IN LABETTE CREEK NEAR OSWEGO, ABOUT 150 CFS. BOTH STREAMS HAVE EXPERIENCED PERIODS OF NO FLOW. THE QUALITY OF THE SURFACE WATER IS GOOD. A 1:63,360 SCALE MAP SHOWS GEOLOGIC UNITS, DEPTH TO WATER, AND DEPTH, YIELD, AND ALTITUDE OF WELLS. TABLES GIVE WATER-BEARING CHARACTERISTICS OF THE GEOLOGIC UNITS AND ANALYSES OF WATER FROM 76 REPRESENTATIVE WELLS. (25 REFERENCES)

Physical and Hydrologic Environments of the Mulberry Coal Reserves in Eastern Kansas
Kenny, J. F., Bevans, H. E., and Diaz, A. M.
U.S. Geological Survey Water-Resources Investigations 82-4074.

Strippable reserves of Mulberry coal underlie an area of approximately 300 square miles in Miami, Linn, and Bourbon Counties of eastern Kansas. Although subject to State reclamation law, current and projected strip mining of this relatively thin coal seam could alter the hydrologic environment of the study area. Drained by the Marais des Cygnes and Little Osage Rivers and their tributaries, this area is characterized by low relief and moderately impermeable soils. Streamflows are poorly sustained by ground-water discharge and fluctuate widely due to climatic extremes and usage of surface-water supplies. Because ground-water supplies are generally unreliable in quantity and quality, surface water is used to meet most water requirements in the study area. Primary uses of surface waters are for domestic supplies, maintenance of wildlife and recreational areas, and cooling needs at the LaCygne Power Plant. The prevailing chemical type of the natural streamflow is calcium bicarbonate, with concentrations of dissolved solids generally less than 500 milligrams per liter and pH near neutral.

Additional streamflow and water-quality data are needed to evaluate pre-mining characteristics and any changes in the hydrologic environment as strip mining proceeds within the study area. A network of data collection stations and a sampling scheme have been established to acquire this additional information.

Geology and Ground-Water Resources of Miami County, Kansas
Miller, Don E.
U.S. Geological Survey Bulletin 181.

Ground Water in the Grand (Neosho) River Basin, Kansas and Oklahoma
Morton, Robert B., and Fader, Stuart W.
U.S. Geological Survey Open-File Report 75-366

Geology and Ground-Water Resources of Montgomery County, Southeastern Kansas
O'Connor, Howard G.
U.S. Geological Survey Ground-Water Series No.1

Discharge Estimates in Surface-Mine Areas using Channel-Geometry Techniques
Osterkamp, W. R., and Hedman, E. R.
U.S. Geological Survey

Surface-mining and reclamation practices generally require extensive hydrologic knowledge of an area. Adequate streamflow data from instrumented sites rarely are available for surface-mine areas, and estimates of streamflow based on rainfall-runoff models, drainage area and basin characteristics, or transfer of streamflow records from gaged to ungaged basins, sometimes have proven unreliable. Channel-geometry measurements offer an alternative method of estimating streamflow characteristics at ungaged sites. The method uses the empirical development of simple or multiple power-function equations yielding a discharge value from channel-configuration and channel-material data. The equations have been developed by collecting geometry and sediment data at numerous gaged sites and statistically relating those data to specified discharge characteristics.

The principal advantage of the channel-geometry method is that estimates of discharge can be obtained quickly and inexpensively. Often results are as reliable as 5 to 10 years of continuous streamflow records. Relatively recent changes in flow regimen, such as those caused by depletion of streamflow by ground-water withdrawals or diversion for irrigation, are detectable by channel-geometry techniques.

Discharges of perennial streams in coal-mine areas can be estimated using equations developed from data of the central and western United States. Equations intended specifically for ephemeral channels in areas of strippable coal resources in arid and semiarid areas have been developed from data collected in the western half of the conterminous United States.

Quality-of-water data and statistical summary for selected coal-mined strip pits in Crawford and Cherokee Counties, southeastern Kansas
Pope, L. M., and Diaz, A. M., 1982
U.S. Geological Survey Open-File Report 82-1021, 28 p.

GEOLOGY AND GROUNDWATER RESOURCES OF LINN COUNTY, KANSAS
SEEVERS, WILLIAM J.
KANSAS STATE GEOLOGICAL SURVEY, LAWRENCE.
KANSAS GEOLOGICAL SURVEY BULLETIN 193, NOVEMBER 1969. 65 P, 9 FIG, 1 PLATE, 4 TAB, 66 REF.,
Journal Announcement: SWRA0312
LINN COUNTY IS LOCATED ALONG THE KANSAS-MISSOURI BOUNDARY IN EAST-CENTRAL KANSAS AND IS A NEARLY SQUARE AREA OF ABOUT 605 SQUARE MILES. ONLY VERY SMALL QUANTITIES OF GROUNDWATER ARE OBTAINED FROM PENNSYLVANIAN ROCKS IN LINN COUNTY. YIELDS RARELY EXCEED 1 GALLON PER MINUTE AND ARE NORMALLY BARELY SUFFICIENT FOR DOMESTIC PURPOSES. LIMESTONES ARE THE MOST PRODUCTIVE AQUIFERS, AND LIMESTONES OF THE LOWER PART OF THE KANSAS CITY GROUP ARE THE BEST OF THE BEDROCK AQUIFERS. GROUNDWATER BELOW A DEPTH OF ABOUT 100 FEET IN THIS AREA IS NORMALLY TOO HIGHLY MINERALIZED FOR USE. LARGE QUANTITIES (30 TO 100 GPM) OF GOOD QUALITY WATER ARE OBTAINED FROM PROPERLY CONSTRUCTED AND DEVELOPED WELLS IN ILLINOISAN AND WISCONSINAN VALLEY-FILL DEPOSITS, MAINLY FROM THIN GRAVEL DEPOSITS NEAR THE BASE. (KNAPP-USGS)

Geology and Ground-Water Resources of Jackson County, Kansas
Walter, Kenneth L.
U.S. Geological Survey Bulletin 101.

GEOHYDROLOGY OF ATCHISON COUNTY, NORTHEASTERN KANSAS
WARD, J. R.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
FOR SALE BY U.S. GEOLOGICAL SURVEY, WASHINGTON, D.C. 20242. PRICE $1.25 PER SET. HYDROLOGIC INVESTIGATIONS ATLAS HA-467, 1973. 2 SHEETS, 1 TAB, 13 REF.,
Journal Announcement: SWRA0712
INFORMATION IS PRESENTED ON THE GROUNDWATER RESOURCES OF ATCHISON COUNTY, KANSAS. BEDROCK OF LATE PENNSYLVANIAN AGE IS EXPOSED THROUGHOUT THE COUNTY. UNCONSOLIDATED GLACIAL DRIFT, LOESS, DEPOSITS BENEATH TERRACES, AND ALLUVIUM OVERLIE THE BEDROCK SURFACE. BOTH TOPOGRAPHY AND TEXTURE OF THE GLACIAL DRIFT EXERT A STRONG INFLUENCE ON RECHARGE TO AND DISCHARGE FROM THE AQUIFERS. DISCHARGE FROM THE AQUIFERS IS PRIMARILY TO STREAMS THAT DRAIN THE COUNTY. SOME DISCHARGE OCCURS FROM SEEPS AND SPRINGS ALONG VALLEY WALLS AND FROM WELLS. A FEW WELLS IN THE COUNTY FLOW CONTINUOUSLY. THE UNCONSOLIDATED PLEISTOCENE

DEPOSITS ARE THE BEST POTENTIAL SOURCES OF GROUNDWATER IN THE COUNTY. THE MOST FAVORABLE AREAS OVERLIE BURIED VALLEYS. FOUR AREAS EXIST WHERE WATER FLOWS AT THE SURFACE DUE TO ARTESIAN PRESSURE. WELLS ARE COMPLETED IN BEDROCK, GLACIAL DRIFT, AND ALLUVIAL AQUIFERS. A SUMMARY OF THE CONCENTRATIONS OF SELECTED DISSOLVED MINERAL CONSTITUENTS IS SHOWN ON THE CORRELATION OF STRATIGRAPHY AND WATER QUALITY DIAGRAM. MOST OF THE WATER IS OF THE CALCIUM BICARBONATE TYPE. ALTHOUGH HARD, IT GENERALLY CAN BE SOFTENED BY SIMPLE TREATMENT. DISSOLVED-SOLIDS CONCENTRATIONS ARE GENERALLY HIGH, BUT ACCEPTABLE. THE HIGHEST CONCENTRATIONS OF DISSOLVED SOLIDS ARE IN WATER FROM THICK GLACIAL DEPOSITS. (KNAPP-USGS)

GEOHYDROLOGY OF ATCHISON COUNTY, NORTHEASTERN, KANSAS
WARD, JOHN R.
KANSAS GEOLOGICAL SURVEY, LAWRENCE.
GEOLOGICAL SURVEY OPEN-FILE REPORT, 1971. 22 P, 6 FIG, 3 PLATE, 1 TAB, 12 REF.,
Journal Announcement: SWRA0424

DATA CONCERNING GROUNDWATER RESOURCES IN ATCHISON COUNTY, KANSAS ARE PRESENTED. THE UNCONSOLIDATED PLEISTOCENE DEPOSITS ARE THE BEST POTENTIAL SOURCES OF GROUNDWATER IN THE COUNTY. BECAUSE THE WISCONSIN TERRACE DEPOSITS AND THE ALLUVIUM ARE PRINCIPALLY SILT AND CLAY THROUGHOUT MOST OF THE COUNTY, YIELDS ARE GENERALLY SMALL. HOWEVER, ALLUVIUM ALONG THE MISSOURI RIVER IS COMPOSED OF VERY PERMEABLE SAND AND GRAVEL FROM WHICH WELL YIELDS OF 2,000 GPM ARE POSSIBLE. AN AQUIFER TEST IN THE ALLUVIUM SHOWED A WATER-LEVEL DRAWDOWN OF 11.3 FEET AFTER PUMPING 1,305 GPM CONTINUOUSLY FOR 155 MINUTES. THE SPECIFIC CAPACITY FOR THE TEST WAS 115 GPM PER FOOT OF DRAWDOWN. THE HYDRAULIC CONDUCTIVITY WAS ABOUT 2,050 GPD PER SQUARE FOOT. FOUR AREAS EXIST WHERE WATER FLOWS AT THE SURFACE DUE TO ARTESIAN PRESSURE. DISSOLVED-SOLIDS CONCENTRATIONS THROUGHOUT THE COUNTY GLACIAL DEPOSITS. (WOODARD-USGS)

GEOHYDROLOGY OF JEFFERSON COUNTY, NORTHEASTERN KANSAS
WINSLOW, J. D.
KANSAS STATE GEOLOGICAL SURVEY, LAWRENCE.
KANSAS GEOLOGICAL SURVEY BULLETIN 202, PART 4, APRIL 1972. 20 P, 2 FIG, 1 PLATE, 3 TAB, 15 REF.,
Journal Announcement: SWRA0519

GEOHYDROLOGIC DATA FOR JEFFERSON COUNTY, KANSAS, ARE BASED ON GEOLOGIC MAPPING, GEOLOGIC INTERPRETATION OF AERIAL PHOTOGRAPHS, TEST-HOLE LOGS AND DRILLERS' LOGS, INVENTORY OF SELECTED WELLS, AND ANALYSES OF WATER SAMPLES FROM SELECTED WELLS. THE LARGEST QUANTITIES OF GROUNDWATER ARE AVAILABLE FROM WELLS IN ALLUVIUM IN THE KANSAS RIVER VALLEY WITH YIELDS OF AS MUCH AS 1,350 GPM. BECAUSE THE USE OF GROUNDWATER FOR IRRIGATION IS SEASONAL, AND BECAUSE PUMPING FOR MUNICIPAL OR PUBLIC-SUPPLY USE IS SMALL COMPARED WITH THE AMOUNT OF GROUNDWATER AVAILABLE, THE NATURAL SLOPE OF THE WATER TABLE IN

THE AREA ESSENTIALLY IS UNAFFECTED. THE CONCENTRATION OF DISSOLVED TABULATED. (WOODARD-USGS)

WATER RESOURCES DATA FOR KANSAS - Published annually since 1971
GEOLOGICAL SURVEY, LAWRENCE, KANS. WATER RESOURCES DIV.
GEOLOGICAL SURVEY BASIC DATA REPORTS.

WATER-RESOURCES DATA FOR KANSAS INCLUDE RECORDS OF DATA FOR THE CHEMICAL AND PHYSICAL CHARACTERISTICS OF SURFACE WATER AND GROUNDWATER. RECORDS FOR A FEW PERTINENT WATER-QUALITY STATIONS IN BORDERING STATES ARE ALSO INCLUDED. THE WATER-QUALITY RECORDS FOR SURFACE WATERS INCLUDE DESCRIPTIONS OF THE SAMPLING STATIONS AND TABULATIONS OF THE DATA FOR THE SAMPLES ANALYZED. THE DESCRIPTION OF THE SAMPLING STATION GIVES THE LOCATION, DRAINAGE AREA, PERIODS OF RECORD FOR THE VARIOUS WATER-QUALITY DATA, EXTREMES OF THE PERTINENT DATA, AND GENERAL REMARKS. FOR GROUNDWATER SAMPLING SITES, THE WELL NUMBER, DEPTH OF WELL, DATE OF SAMPLING, AND OTHER PERTINENT DATA ARE GIVEN IN THE TABLE CONTAINING THE CHEMICAL ANALYSES OF GROUNDWATER. TABLES INCLUDE CHEMICAL, BIOLOGICAL, MICROBIOLOGICAL, WATER TEMPERATURE, AND FLUVIAL SEDIMENT DATA. (WOODARD-USGS)

Water Resources Data for Kansas, published annually since 1975
Geological Survey, Lawrence, KS. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161.

Water resources data for Kansas, presented in two volumes, consist of records of stage, discharge, and water quality streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells. All data in this report represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kansas. (USGS).

Public and industrial water supplies of the Eastern Coalfield Region, Kentucky

Baker, J. A., Price, W. E., Jr., 1956

U.S. Geological Survey Circular 369

About 115,100,000 gal/d (gallons per day) of water is pumped for 119 large public and industrial water supplies in the 29 counties of the Eastern Coalfield Region of Kentucky. About 12 percent of water is used for public supply and about 88 percent for industrial supply. Public supplies provide 191,000 people with water, and per capita consumption ranges from 12 to possibly 460 gal/d. The quantity of water pumped in a public supply for industrial use is sometimes more than half the total water provided. Industries in the region use water primarily for cooling. The largest amounts are used for coal washing, gas transmission, petroleum processing, railroad supply, and coal- and steel-products manufacture.

About 6 percent of the water pumped for public and industrial supplies is ground water and about 94 percent is surface water. However, of the total number of cities, industries, and institutions supplied, ground water provide 37 percent of the supply, surface water, 52 percent, and ground and surface water combined, 11 percent.

Large ground-water supplies in the region are obtained principally from wells and abandoned coal mines, but a few are obtained from springs. Wells yield from 2 to 330 gal/min (gallons per minute) and get most of their water from sandstone in rocks of Pennsylvanian age and from sand and gravel in alluvium of Quaternary age. Most water is of the calcium or magnesium bicarbonate or sodium bicarbonate type; however, some water is high in iron content and some has a large proportion of sulfate.

Most of the surface water pumped in the Eastern Coalfield is from the big Sandy River and its tributaries, and from the Ohio River. In the future, surface water will be the principal source for towns and industries needing large quantities of water. (Authors' abstract).

Drainage Areas of Streams at Selected Locations in Kentucky

Hower, D. E.; Jackson, W. H.

Geological Survey, Louisville, KY. Water Resources Div.

Geological Survey Open-File Report 81-61, 1981. 118 p, 1 Fig, 12 Tab.,

Journal Announcement: SWRA1506

The drainage areas for more than 2,000 selected sites throughout Kentucky were determined. Areas of limestone terrain characterized by sinkholes are indicated in basins where they have been determined. Each location is referenced by U.S. Geological Survey station number (where assigned), latitude, longitude, county code, topographic quadrangle, river distance, and in some cases by nearby town or landmark. All values are given in both English and metric units and an alphabetical index by stream name is provided. (USGS)

Influences of strip mining on the hydrologic environment of parts of Beaver Creek basin, Kentucky, 1955-59
Collier, C. R., and others, 1964
U.S. Geological Survey Professional Paper 427-B, 85 p.

Influences of strip mining on the hydrologic environment of parts of Beaver Creek basin, Kentucky, 1955-66
Collier, C. R., Pickering, R. J., and Musser, J. J., editors, 1970
U.S. Geological Survey Professional Paper 427-C, 79 p.

a Fluvial Sediment Study of Fishtrap and Dewey Lakes Drainage Basins, Kentucky - Virginia
Curtis, W. F.; Flint, R. F.; George, F. H.; Santos, J. F.
Geological Survey, Louisville, KY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A056 573, Price codes: A06 in paper copy, A01 in microfiche. Water-Resources Investigations 77-123, March 1978. 92 p, 28 fig, 9 tab, 50 ref.,
Journal Announcement: SWRA1123

Fourteen drainage basins above Fishtrap and Dewey Lakes in the Levisa Fork and Johns Creek drainage basins of eastern Kentucky and southwestern Virginia were studied to determine sedimentation rates and origin of sediment entering the two lakes. The basins ranged in size from 1.68 to 297 square miles. Sediment yields ranged from 2,890 to 21,000 tons per square mile where surface-mining techniques predominated, and from 732 to 3,470 tons per square mile where underground mining methods predominated. Yields, in terms of tons per acre-foot of runoff, ranged from 2.2 to 15 for surface-mined areas, and from 0.5 to 2.7 for underground-mined areas. Water and sediment discharges from direct runoff during storms were compared for selected surface-mined and underground-mined areas. Data points of two extensively surface-mined areas, one from the current project and one from a previous project in Beaver Creek basin, McCreary County, Kentucky, grouped similarly in magnitude and by season. Disturbed areas from mining activities determined from aerial photographs reached 17 percent in one study area where extensive surface mining was being practiced. For most areas where underground mining was practiced, percentage disturbed area was almost negligible. Trap efficiency of Fishtrap Lake was 89 percent, and was 62 percent for Dewey Lake. Average annual deposition rates were 464 and 146 acre-feet for Fishtrap and Dewey Lakes, respectively. The chemical quality of water in the Levisa Fork basin has been altered by man's activities. (Woodard-USGS)

A Flood Model for the Tug Fork Basin, Kentucky, Virginia, and West Virginia.

Doyle, W. Harry, Curwick, Philip B., and Flynn, Kathleen.

U.S. Geological Survey Water-Resources Investigations Report 83-4014.

Surface mining of coal in the United States increased from 406 million tons to almost 800 millions tons from 1978 to 1979. In the coal-rich 1,560-square-mile Tug Fork basin located in Kentucky, Virginia, and West Virginia, there has been a 2,500 percent increase since 1950 in areas affected by surface-mining activities.

This study used a rainfall-runoff model to determine if land-use changes associated with surface mining in the Tug Fork basin have affected basin streamflow characteristics. The model was calibrated and verified for two periods, one representing 1980 land-use and one representing 1950 land-use. Two 29-year synthetic daily streamflow time series representing the two land-use conditions were generated. Statistical tests performed on the two time series at 15 points in the basin showed no difference at the 0.01 percent confidence level at any of the locations.

In addition, analyses were made to determine if future increases in surface-mining activities might affect basin streamflow. One analysis showed that increasing mining in an upland watershed by as much as 200 percent had little effect on streamflow in the intermediate area and no effect on streamflow at downstream locations along the Tug Fork. Even for a scenario where all areas disturbed by mining were assumed totally impervious, the modeling process demonstrated that the increase in mean-annual 1-day high flows (for recurrence intervals of 2, 5, 10, 25, 50, 100, and 100 years) was less than 4 percent at the basin outlet.

The effects of mine acid on the Pond River watershed in western Kentucky

Dyer, R., 1977

U.S. Geological Survey Water-Resources Bulletin, v. 13, no. 5, p. 1069-1074.

Effects on Water Quality of Coal Mining in the Basin of the North Fork Kentucky River, Eastern Kentucky.

Dyer, Kenneth L.

U.S. Geological Survey WRI 81-215.

A detailed investigation of the effects of mine drainage on stream water quality was carried out on the watershed of the North Fork Kentucky River in 1975. Specific-conductance measurements were made at 415 sites, repeatedly at some of them. Discharge estimates and pH values, were also obtained in most instances while sulfate and chloride data were obtained about half the time.

Based on a daily sulfate record simulated from daily conductivity values, trends in sulfate loads were assessed for the North Fork Kentucky River at Hazard for the 1963 through 1973 water years. The mean annual sulfate concentration declined from a maximum of 140 milligrams per liter in the 1963 water year to 72 milligrams per liter in the 1973 water year, about half of what it had been 11 years earlier. The irregular appearance of acid and high sulfate discharges in the earlier years indicates that these probably originated as sudden releases of water from underground mines or as water flushed from coal washing ponds.

Over the area as a whole, coal mining has caused the mean annual dissolved-solids concentration to increase from about 50 to 150 milligrams per liter while the most responsive ion, sulfate, increased in concentration from about 8 to 50 milligrams per liter.

The most damaging effect of strip mining on water quality appears to be the generation of sediment. Even in those watersheds where streams are adequately protected by silt-catchment dams and ponds, both road construction and the dam construction itself may, for a time, introduce large quantities of sediment into the streams. Strip mining of the Hazard Number 9 seam near Hazard has introduced large quantities of acid sulfate mine drainage into Lotts Creek, Yellow Creek, and other streams, but still only a very small part of the total study area is severly affected by acid water.

The bulk of acid mine drainage produced in the study area is immediately neutralized by carbonate minerals or replaced by exchangeable bases from the aquifer material before it ever reaches the streams. The most acid water sample collected during this study had already lost 63 percent of the acidity presumed to have originally been associated with the sulfates in the sample.

Unusually high concentrations of several trace elements were observed in acid mine drainage and in streams affected by it, but in no case were these at levels harmful to human health; although both iron and manganese concentrations were commonly high enough to give the water a bad taste and to leave deposits on containers. The highest concentrations observed for some of the trace elements include: 76 micrograms per liter total arsenic, 400 micrograms per liter dissolved colbalt, 100 micrograms per liter dissolved copper, 82,000 micrograms per liter dissolved iron, 1,000 micrograms per liter total lead, 22,000 micrograms per liter dissolved manganese, 1,200 micrograms per liter dissolved nickel, and 67 micrograms per liter dissolved vanadium.

Some watersheds, especially those where only the Fire Clay and Leatherwood seams have been mined, have recovered to the point where the water draining from them is similar in pH and in concentrations of dissolved solids to that which was present prior to mining.

Effects of coal mining on small streams of the Levisa Fork

basin, Kentucky
Dysart, J. E.
U.S. Geological Survey Water-Resources Investigation

Downstream effects of coal mining on the surface-water quality of the Levisa Fork basin, Kentucky-Virginia
Dysart, J. E.
U.S. Geological Survey Water-Resources Investigation

EFFECTS OF COAL MINING ON THE WATER RESOURCES OF THE TRADEWATER RIVER BASIN, KENTUCKY
GRUBB, H. F.; RYDER, P. D.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
AVAILABLE FROM GPO, WASHINGTON, D.C. 20402 PRICE $2.10. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1940, 1972. 83 P, 26 FIG, 20 TAB, 38 REF.,
Journal Announcement: SWRA0610
THE EFFECTS OF COAL-MINE DRAINAGE ON THE WATER RESOURCES OF THE TRADEWATER RIVER BASIN, IN THE WESTERN COAL FIELD REGION OF KENTUCKY, WERE EVALUATED (1) BY SYNTHESIS AND INTERPRETATION OF 16 YEARS OF DAILY CONDUCTANCE DATA, 465 CHEMICAL ANALYSES COVERING AN 18-YEAR PERIOD, 28 YEARS OF DAILY DISCHARGE DATA, AND 14 YEARS OF DAILY SUSPENDED-SEDIMENT DATA FROM THE TRADEWATER RIVER AT OLNEY AND (2) BY COLLECTION, SYNTHESIS, AND INTERPRETATION OF CHEMICAL AND PHYSICAL WATER-QUALITY DATA AND WATER-QUANTITY DATA COLLECTED OVER A 2-YEAR PERIOD FROM MINED AND NONMINED SITES IN THE BASIN. MAXIMUM OBSERVED VALUES OF 13 CHEMICAL AND PHYSICAL WATER-QUALITY PARAMETERS WERE THREE TO 300 TIMES GREATER IN THE DISCHARGE FROM MINED SUBBASINS THAN IN THE DISCHARGE FROM NONMINED SUBBASINS. POTASSIUM, CHLORIDE, AND NITRATE CONCENTRATIONS WERE NOT SIGNIFICANTLY DIFFERENT BETWEEN MINED AND NONMINED AREAS. MEAN SULFATE LOADS CARRIED BY THE TRADEWATER RIVER AT OLNEY WERE ABOUT 75% GREATER FOR THE PERIOD 1955-67 THAN FOR THE PERIOD 1952-54. SUSPENDED-SEDIMENT LOADS AT OLNEY FOR THE NOVEMBER-APRIL STORM-RUNOFF PERIODS GENERALLY VARY IN RESPONSE TO STRIP-MINE COAL PRODUCTION IN THE BASIN ABOVE OLNEY. STREAMFLOW IS MAINTAINED DURING EXTENDED DRY PERIODS IN MINED SUBBASINS AFTER STREAMS IN NONMINED SUBBASINS HAVE CEASED FLOWING. SOME POSSIBLE METHODS OF REDUCING THE EFFECTS OF MINE DRAINAGE ON THE STREAMS ARE CONSIDERED. (WOODARD-USGS)

FLOODS ON LICKING RIVER IN VICINITY OF SALYERSVILLE, KENTUCKY
HANNUM, CURTIS H.
GEOLOGICAL SURVEY, LOUISVILLE, KY.
U S GEOL SURV OPEN-FILE REP, 17 P, MAY 1968. 7 FIG, 1 PLATE, 2 PHOTO.,
Journal Announcement: SWRA0207

FLOODS ON LICKING RIVER NEAR SALYERSVILLE, KENTUCKY, WERE STUDIED TO OBTAIN HYDROLOGIC DATA THAT CAN BE USED TO EVALUATE THE EXTENT, DEPTH, AND FREQUENCY OF FLOODS THAT AFFECT THE ECONOMY OF DEVELOPMENTS ON THE FLOOD PLAINS. THE DATA PROVIDES A BASIS FOR SOLVING EXISTING FLOOD PLAIN PROBLEMS AND FOR REGULATING FUTURE LAND USE AND DEVELOPMENT TO REDUCE FUTURE FLOOD DAMAGE BY BUILDING AND ZONING REGULATIONS, LOCATING WASTE DISPOSAL AND WATER TREATMENT FACILITIES, AND DEVELOPING RECREATIONAL AREAS. THE AREAS INUNDATED BY 5, 25, AND 50-YR FLOODS ARE SHOWN ON A TOPOGRAPHIC MAP, SCALE 1:12,000. HEIGHTS OF FLOODS ARE TABULATED. ANNUAL FLOODS ARE SHOWN GRAPHICALLY DEMONSTRATING THE IRREGULARITY OF FLOOD HEIGHTS AND THE TYPICAL MAGNITUDES OF FLOODS. FOR EACH GAGING STATION IN THE AREA, FLOOD DISCHARGES AND GAGE HEIGHTS ARE TABULATED. MAJOR FLOOD PROFILES ARE DRAWN. THE FREQUENCY-GAGE HEIGHT RELATIONSHIP IS SHOWN GRAPHICALLY. (KNAPP-USGS)

Occurrence of fresh water in the Lee Formation in parts of Elliott, Johnson, Lawrence Magoffin, and Morgan Counties, Eastern Coal Field Region, Kentucky
Hopkins, H. T., 1970
U.S. Geological Survey Water Supply Paper 1867, 44 p.

GROUNDWATER
HOPKINS, H. T.; MULL, D. S.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
IN: INFLUENCES OF STRIP MINING ON THE HYDROLOGIC ENVIRONMENT OF PARTS OF BEAVER CREEK BASIN, KENTUCKY, 1955-66, GEOLOGICAL SURVEY PROFESSIONAL PAPER 427-C, P C9-C14, 1970. 6 P, 4 FIG.,
Journal Announcement: SWRA0415

THE EFFECTS OF MINING ON THE OCCURRENCE,. MOVEMENT, AND QUALITY OF GROUNDWATER WERE STUDIED IN THE CANE BRANCH STUDY AREA, KENTUCKY. GROUNDWATER IN THE ESSENTIALLY UNMINED WEST FORK CANE BRANCH STUDY AREA WAS ALSO INVESTIGATED TO PROVIDE A BASIS FOR COMPARISON. THERE HAS BEEN NO SIGNIFICANT CHANGE IN THE OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE VICINITY OF THE SOUTHWEST SPOIL BANK SINCE BEGINNING OF OBSERVATIONS IN THE SPRING OF 1958. SHALLOW GROUNDWATER IN BEDROCK IS RECHARGED BY PRECIPITATION AND MOVES FROM TOPOGRAPHICALLY HIGH AREAS TO STREAMS. GROUNDWATER IN THE SOUTHWEST SPOIL BANK IS RECHARGED BY DIRECT INFILTRATION OF PRECIPITATION AND SEEPAGE FROM ADJACENT POOLS, AND IT DISCHARGES MOSTLY EASTWARD INTO TRIBUTARIES DRAINAGE THE SPOIL BANK AREA. FLUCTUATIONS OF THE WATER TABLE IN THE SPOIL BANK ARE LARGELY CONTROLLED BY DIRECT INFILTRATION OF PRECIPITATION DURING THE WINTER-SPRING SEASON, BUT THEY ARE STRONGLY INFLUENCED BY SEEPAGE FROM POOLS ADJACENT TO THE SPOIL BANK DURING THE SUMMER-AUTUMN SEASON. THE SHAPE AND SLOPE OF THE WATER TABLE IN THE SPOIL BANK HAVE NOT CHANGED SIGNIFICANTLY SINCE OBSERVATIONS

BEGAN IN 1958. (SEE ALSO W71-07935) (KNAPP-USGS)

Hydrology of area 13, Eastern Coal Province, Kentucky, Virginia, West Virginia
Kiesler, J., Quinones, F., Mull, D. S., and York, K. L.
U.S. Geological Survey

Surface mine water quality control in the Eastern Kentucky Coalfields
Kimball, R. L., 1974
Report to Kentucky Department of Natural Resources Environmental Protection and Appalachian Regional Commission, 92 p.

This report is concerned with acid mine drainage and other forms of chemical water pollution attributed to surface mining in the Eastern Kentucky Coalfield and gives primary emphasis to identifying coal seams with the highest acid-producing potential. The parameters, Criteria, and methodology developed and used to achieve this end are described. The research effort included a general evaluation of existing water- quality data for all the major drainage basins in the Eastern Kentucky Coalfield, followed by a concentrated study in Kentucky, Big Sandy, and Cumberland River basins. (Adapted from Summary.)

Influences of Strip Mining on the Hydrologic Environment of Parts of Beaver Creek Basin, Kentucky, 1973-74.
Krieger, Robert A., and Others.
U.S. Geological Survey Professional Paper 427-D.

WATER IN KENTUCKY
KRIEGER, R. A.; CUSHMAN, R. V.; THOMAS, N. O.
GEOLOGICAL SURVEY, WASHINGTON, D. C.
KENTUCKY GEOL SURV SER 10. SPEC PUBLICATION NO 16, 1969. 51 P, 23 FIG, 39 PHOTO, 4 TAB, 126 REF.,
Journal Announcement: SWRA0219

THE WATER RESOURCES, WATER USE, WATER PROBLEMS, AND WATER LAW OF KENTUCKY ARE DISCUSSED IN A PUBLICATION INTENDED FOR PUBLIC EDUCATION TO INCREASE KNOWLEDGE OF THE NATURE, AVAILABILITY, AND MANAGEMENT OF WATER. DATA ON WATER QUALITY, WATER USE, STREAMFLOW, GROUNDWATER LEVEL, RESERVOIR CAPACITY AND PRECIPITATION ARE TABULATED. A BIBLIOGRAPHY OF KENTUCKY WATER INFORMATION IS INCLUDED. (KNAPP-USGS)

Hydrology of area 15, Eastern Coal Province, Kentucky, Tennessee
Leist, D. W., Quinones, F., Mull, D. S., and Young, M.
U.S. Geological Survey

PRECIPITATION AND RUNOFF
MCCABE, J. A.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
IN: INFLUENCES OF STRIP MINING ON THE HYDROLOGIC ENVIRONMENT OF PARTS OF BEAVER CREEK BASIN, KENTUCKY, 1955-66, GEOLOGICAL SURVEY PROFESSIONAL PAPER 427-C, P C5-C9, 1970. 5 P, 4 FIG, 1 TAB.,
Journal Announcement: SWRA0415

THE RUNOFF CHARACTERISTICS OF CANE BRANCH AND HELTON BRANCH BASINS OF KENTUCKY WERE STUDIED TO RELATE ANY OBSERVED DIFFERENCES BETWEEN THE TWO BASINS TO DIFFERENCES IN THEIR EXPOSURE TO STRIP MINING. THE DRAINAGE BASIN OF CANE BRANCH INCLUDES STRIP-MINED AREAS, WHEREAS THE DRAINAGE BASIN OF HELTON BRANCH HAS NOT BEEN DISTURBED BY STRIP MINING. THERE WERE MEASURABLE DIFFERENCES IN RUNOFF CHARACTERISTICS BETWEEN THE TWO BASINS, DESPITE THE FACT THAT SIMILAR PERCENTAGES OF ANNUAL PRECIPITATION GO TO RUNOFF AND EVAPOTRANSPIRATION IN EACH BASIN. APPLICATION OF BOTH FLOW-DURATION AND ANNUAL-FLOOD METHODS TO ANALYSIS OF STREAM HYDROGRAPHS INDICATED THAT CANE BRANCH HAS GREATER PEAK FLOWS PER SQUARE MILE OF DRAINAGE AREA AND MORE RAPID CHANGES IN DISCHARGE, BUT HELTON BRANCH HAS GREATER BASE FLOWS. HOWEVER, AN EXAMINATION OF THE HYDROLOGIC DATA FOR PROGRESSIVE CHANGE IN RUNOFF CHARACTERISTICS OF CANE BRANCH THAT COULD BE RELATED TO THE HISTORY OF MINING IN THE AREA FAILED TO INDICATE ANY SUCH CHANGE. (SEE ALSO W71-07935) (KNAPP-USGS)

Influences of strip mining on the hydrologic environment of parts of Beaver Creek basin, Kentucky, 1973-74
McCabe, J. A., 1962
U.S. Geological Survey Professional Paper 427-D

Public and industrial water supplies of the Western Coal Region, Kentucky
Maxwell, B. W., 1954
U.S. Geological Survey Circular 339

Data on the source, pumpage, treatment, and storage of water for 88 public and industrial water supplies in the 10 counties of the Western Coalfield Region of Kentucky are presented.

The total daily pumpage of water in the region is about 50,000,000 gallons. Seventy-two percent of this is obtained from wells and 28 percent is obtained from surface supplies. The Quaternary alluvium provides about 91 percent of the ground water used in the region. Of the total pumpage, 24 percent is used for all purposes from public supplies. The daily consumption of water per person from public supplies ranges from 21 to 197 gallons and averages 110 gallons. The chief industrial consumption of water is for coal washing, production of chemicals, distilling, and secondary recovery of petroleum.

The region is the southern part of a large basin of shales and sandstones of Pennsylvanian age which is overlain in places by alluvial sands and gravels and silts of Quaternary and Recent age. The chief aquifers are the Pennsylvanian sandstones and the sands and gravels of the alluvium. The water in the Pennsylvanian sandstones is fresh in the outcrop areas and becomes progressively more mineralized towards the center of the basin. Yields from the Pennsylvanian sandstones range from a few gallons per minute up to 500 gal/min. Water in the alluvium ranges from hard to very hard and may be pumped from vertical wells at rates up to at least 1,000 gal/min. (Author's abstract.)

Reconnaissance of ground-water resources in the Western Coal Field region, Kentucky
Maxwell, B. W., and DeVaul, R. W., 1962d
U.S. Geological Survey Water-Supply Paper 1599, 34 p.

Ground-water resources of the Jenkins-Whitesburg area, Kentucky
Mull, D. S., 1965
U.S. Geological Survey Water-Supply Paper 1809-A, 36 p.

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky
Mull, D. S.; Cordiviola, S.; Risser, D. W.
Geological Survey, Louisville, KY. Water Resources Div.
Geological Survey Open-File Report 81-690 (WRI), 1981. 51, p 14 Fig, 2 Plates, 12 Tab, 35 Ref.,
Journal Announcement: SWRA1512
The location and mine volume is shown for all abandoned coal mines that contained water in Johnson and Martin Counties, Ky. The principal factors that affect the occurrence of water in coal mines is mine size, intensity and duration of precipitation and the location of the mine relative to the developed above drainage whereas water usually must be pumped from flooded galleries of mines below drainage. Ten above-drainage mines discharged from 12 to 1,700 gallons of water per minute. Sustained discharge from the largest above-drainage mine ranged from 750 to 1,200 gallons per minute. Eight below drainage mines are considered potential sources of water. Test pumping and hydrographs indicate the seasonal recharge rate into below drainage mines varies from 660 to 103,500 gallons per day. Estimates of water stored in individual mines ranged from 22 to 1,462 million gallons. This water could sustain a supply through periods of limited recharge to the mine. Most mine water is a calcium magnesium sulfate type. Hardness ranged from soft to very hard and pH ranged from 3.1 to 8.0 units. The concentration of most dissolved constituents was

lower in water from below-drainage mines than in water from those above-drainage. (USGS)

PUBLIC AND INDUSTRIAL WATER SUPPLIES OF KENTUCKY, 1968-69
MULL, D. S.; CUSHMAN, R. V.; LAMBERT, T. W.
GEOLOGICAL SURVEY, LOUISVILLE, KY.
KENTUCKY GEOLOGICAL SURVEY SERIES X, INFORMATION CIRCULAR 20, 1970. 107 P, 1 FIG, 2 TAB, 6 REF.,
Journal Announcement: SWRA0424

DATA CONCERNING PUBLIC AND INDUSTRIAL WATER SUPPLIES OF KENTUCKY DURING 1968-69 ARE PRESENTED. AN AVERAGE OF ABOUT 612 MILLION GALLONS OF WATER WAS USED DAILY IN 1968-69 FOR PUBLIC AND INDUSTRIAL WATER SUPPLY IN KENTUCKY. THIS IS AN INCREASE IN TOTAL WATER USE OF 29% OVER 1957-59, AND 54% OVER 1951-53. PUBLIC SUPPLIES ACCOUNTED FOR 31,% AND INDUSTRIAL SUPPLIES 69% OF THE TOTAL WATER USED IN 1968-69. MUNICIPALITIES AND UTILITY WATER DISTRICTS FURNISHED WATER TO 2,185,646 PEOPLE, 84.5% BEING SUPPLIED FORM SURFACE-WATER SOURCES AND 15.5% FROM GROUNDWATER SOURCES. THE AVERAGE DAILY USE WAS ABOUT 190 MILLION GALLONS, A 23% INCREASE OVER 1957-59 AND 30% OVER 1951-53. THE AVERAGE DAILY PER CAPITA USE WAS 86.5 GALLONS. THE PER CAPITA USE SHOWS A WIDE RANGE AMONG COMMUNITIES. IN GENERAL THE LARGER THE CITY OR TOWN, THE LARGER THE PER CAPITA USE. INDUSTRIAL WATER USE IN 1968-69 INCREASED ABOUT 32% OVER 1957-59, A LARGER INCREASE THAN FOR PUBLIC SUPPLIES. THE AVERAGE DAILY USE WAS NEARLY 423 MILLION GALLONS, OF WHICH ABOUT 328 MILLION GALLONS WAS SELF SUPPLIED; THE REMAINDER WAS SUPPLIED BY PUBLIC WATER SYSTEMS. (WOODARD-USGS)

WATER RESOURCES OF THE MIDDLESBORO AREA, KENTUCKY
MULL, D. S.; PICKERING, R. J.
US GEOLOGICAL SURVEY.
US GEOL SURV REP OF INVEST 9, 51 P, 1968. 13 FIG, 7 PLATE, 6 TAB, 41 REF, 1 APPEND.,
Journal Announcement: SWRA6802

WATER RESOURCES INFORMATION FOR THE MIDDLESBORO AREA IS SUMMARIZED AS PART OF THE STATEWIDE STUDY OF WATER AND MINERAL RESOURCES. THE QUANTITY AND QUALITY OF GROUNDWATERS AND SURFACE WATERS RE ADESCRIBED; THE AQUIFERS, WATER USE, AND NATURAL AS WELL AS MAN-MADE CONDITIONS AFFECTING OPTIMUM DEVELOPMENT OF WATER RESOURCES ARE DISCUSSED. A DEPENDABLE WATER SUPPLY IS AVAILABLE FROM A RESERVOIR IN A PROTECTED DRAINAGE BASIN; AMPLE GROUNDWATER IS AVAILABLE FOR PRESENT USE AND FUTURE NEEDS. MOST OF THE GROUNDWATER IS IN CONGLOMERATES AND SANDSTONES OF THE PENNSYLVANIAN LEE FORMATION. ARTESIAN WELLS CAPABLE OF PRODUCING AS MUCH AS 100 GPM EACH CAN BE DEVELOPED; A WELL AND A SPRING EACH OF THAT CAPACITY ARE ALREADY IN USE. SHALLOWER ROCKS OF THE PENNSYLVANIAN BREATHITT GROUP AND THE SHALLOW ALLUVIUM CAN BE DEVELOPED FOR DOMESTIC AND MODEST INDUSTRIAL SUPPLIES. FRACTURES IN THE DISTURBED ROCKS AID RECHARGE AND CIRCULATIO SON THAT GENERALLY AQUIFER WATER IS SATISFACTORY FOR MOST USES WITH LITTLE MORE

TREATMENT THAN IRON REMOVAL. FURTHER DEVELOPMENT OF SURFACE WATER WOULD REQUIRE IMPOUNDMENT. SURFACE WATER QUALITY IS SLIGHTLY IMPAIRED BY ACID MINE DRAINAGE AND WASTE DISPOSAL. FLOOD HAZARDS ARE REDUCED BY CONTROL STRUCTURES.

Description of physical environment and of strip-mining operations in parts of Beaver Creek basin, Kentucky
Muller, J. J., 1963, (1964)
U.S. Geological Survey Professional Paper 427-A, 25 p.

Description of physical environment and of strip-mining operations in parts of Beaver Creek basin, Kentucky
Musser, J. J., 1963
U.S. Geological Survey Professional Paper 427-A, 25 p.

An investigation of the effects of strip mining for coal on the hydrology of parts of the Beaver Creek basin, McCreary County, Ky., was begun by several State and Federal agencies in 1955. This report describes the topography, drainage, geology, soils, climate, hydrologic environment, and forest vegetation of the study areas and gives a history and description of the mining. The following study areas are included: (1) The Cane Branch basin, in which there has been mining; (2) the Helton Branch basin, in which there has been no mining and which is reasonably similar to the Cane Branch basin in physical characteristics; and (3) the West Fork Cane Branch basin, in which there has been some prospecting.

The bedrock of the Beaver Creek basin has been eroded by streams to form a maturely dissected, irregular land surface with narrow, winding ridges and deep, steep-sided, narrow valleys. The drainage area of each study area, in square miles, is as follows: Helton Branch, 0.85; Cane Branch, 0.67; and West Fork Cane Branch, a major tributary to Cane Branch, 0.26. Profiles of the steep stream channels and area-elevation curves of the land slopes show that the study areas are similar topographically. The Helton Branch channel has a bedrock floor. Numerous reaches of the Cane and West Fork Cane Branch channel floors are composed of sediment deposits.

The stratigraphic section is divided into three parts, as follows: (1) The strata below the main cliff-forming sandstone that consist mostly of siltstone and claystone; (2) the main cliff-forming sandstone that makes the steep valley walls; and (3) the strata above the main cliff-forming sandstone that consist of sandstone, siltstone, claystone, and the Barren Fork coal seam in the Cane Branch and West Fork Cane Branch areas and mostly of sandstone in the Helton Branch area.

The spoil banks in the Cane Branch basin are composed of a heterogeneous mixture of sandstone, siltstone, claystone, soil, and water-soluble sulfur compounds. Downstream from the spoil banks, the stream beds and the lower flood plains are composed of fluvial deposits consisting predominantly of clay and silt-size particles that were derived from the spoil banks. In the Helton

Branch basin, fluvial deposits consist of sand- to boulder-size fragments, and in the West Fork Cane Branch basin these deposits consist of silt- to boulder-size fragments.

Several great soil groups occur within the study areas, including the Red-Yellow Podzolic group, the Planosol group, and the Alluvial group. The main soil series present are the Muskingum, Hartsells, Wellston, Johnsburg, Tilsit, and Enders, which have formed from parent sandstone, siltstone, and claystone beds. The hydrologic classification of soils indicates that the Helton and Cane Branch study areas are similar in terms of potential runoff, insofar as the soils are concerned.

The climate of southeastern Kentucky is virtually continental in character. The temperature ranges annually from about 5 to 100 degrees F. The mean annual precipitation is 46 inches. Thunderstorms are common during the spring and summer months. The mean annual snowfall is about 11 inches. Annual runoff averages about 22 inches. Cane and Helton Branches are perennial streams and rarely reach zero flow. West Fork Cane Branch is an intermittent stream and is dry for long periods in the summer and fall.

Chemical weathering has produced the gentle slopes in the uplands of the study areas, and physical weathering has resulted in the formation of the steep valley walls.

The forest vegetation of the study areas consists of stands of pines and oaks on the ridges and of stands of hardwoods and hemlocks in the coves and bottom lands. There are some differences in the percentages of the various forest types in the study areas, but the total percentages of types based on environmental conditions are similar. The Helton Branch area has a larger number of stems per acre than the Cane Branch area.

From 1955 to 1960, four phases of prospecting and mining took place in the Cane and West Fork Cane Branch study areas. From May 1955 to April 1956, the Barren Fork coal seam was strip mined in the southwest side of the Cane Branch area. After mining was completed, the mine operator leveled the spoil bank resulting from the operation and cleared two ditches to allow drainage into Cane Branch.

From October 1957 to January 1959, a second operator drift mined the coal seam in the highwall on the southwest side of the Cane Branch area. Acid water was frequently pumped from the drift mine into Cane Branch during the mining operation.

From the fall of 1958 to August 1959, a third operator strip mined coal in the northeast side of the Cane Branch area. After mining, the new spoil bank was leveled and a ditch cleared to allow drainage into Cane Branch.

During February and March 1960, a fourth operator, in prospecting for coal along the divide between the Cane and West Fork Cane Branch basins, built a small spoil bank in each of these basins. No coal was mined in the areas during this activity.

Geochemistry of water in Collier, C. R., and others, influences of strip mining on the hydrologic environment of parts of Beaver Creek basin, Kentucky
Musser, J. J., and Whetstone, G. W., 1964
U.S. Geological Survey Professional Paper 427-B, p. B42-B44.

GEOCHEMISTRY OF WATER
MUSSER, J. J.; PICKERING, R. J.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
IN: INFLUENCES OF STRIP MINING ON THE HYDROLOGIC ENVIRONMENT OF PARTS OF BEAVER CREEK BASIN, KENTUCKY, 1955-66, GEOLOGICAL SURVEY PROFESSIONAL PAPER 427-C, P C14-C30, 1970. 17 P, 9 FIG, 7 TAB.,
Journal Announcement: SWRAU415

ONE OF THE ENVIRONMENTAL FACTORS MOST OBVIOUSLY INFLUENCED BY STRIP MINING IN THE CANE BRANCH BASIN OF KENTUCKY IS THE CHEMICAL COMPOSITION OF THE WATER. CANE BRANCH IS AN ACID STREAM BECAUSE OF STRIP MINING. THIS REPORT DESCRIBES AND EVALUATES (1) CHANGES IN THE CHEMICAL COMPOSITION OF WATER IN THE CANE BRANCH STUDY AREA, (2) THE CHEMICAL COMPOSITION OF WATER IN NEARBY STUDY AREAS UNAFFECTED BY MINING, AND (3) THE GENERAL PERSISTENCE OF ACID WATER DOWNSTREAM FROM THE CANE BRANCH MINING AREA. ALTHOUGH FLUCTUATIONS OF ANNUAL MEAN CONCENTRATIONS DUE TO CLIMATIC VARIATIONS HAVE MADE IT DIFFICULT TO IDENTIFY A DEFINITE TREND DURING THE PERIOD 1962-66, APPARENTLY THERE WAS LITTLE CHANGE IN THE RATE OF CHEMICAL WEATHERING OR IN THE CHEMICAL COMPOSITION OF THE WATER IN CANE BRANCH DURING THE LAST 5 YEARS OF THE STUDY. AS THE ACID MINE DRAINAGE FROM THE CANE BRANCH AREA MOVES DOWNSTREAM, IT IS DILUTED AND NEUTRALIZED BY INFLOW FROM STREAMS CONTAINING BICARBONATE ALKALINITY. THE EFFECTS OF THE MINE DRAINAGE ARE ALMOST UNDETECTABLE AT THE POINT WHERE WATER FROM LITTLE HURRICANE FORK ENTERS BEAVER CREEK, AND BEAVER CREEK BELOW THIS POINT HAS A SLIGHTLY ACID PH LIKE THAT OF NEIGHBORING STREAMS UNAFFECTED BY ACID MINE DRAINAGE. (SEE ALSO W71-07935) (KNAPP-USGS)

Geology and ground-water resources of the Prestonsburg quadrangle, Kentucky
Price, W. E., Jr., Mull, D. S., and Kilburn, Chabot, 1956
U.S. Geological Survey Water-Supply Paper 1359, 140 p.

Reconnaissance of ground-water resources in the Eastern Coalfield Region, Kentucky
Price, W. E., Mull, D. S., and Kilburn, C., 1962
U.S. Geological Survey Water-Supply Paper 1607, 56 p. Supplemented by U.S. Geological Survey Hydrological Atlases 36, 37, and 38.

The availability of ground water in different parts of this region was determined chiefly by analyzing ground-water data collected during the reconnaissance. The resulting water-availability maps, published as Hydrologic Investigations Atlases, were designed to be used in conjunction with this report.

Water from wells and springs in the Eastern Coalfield Region varies widely in chemical character, but most of the water is of the calcium magnesium bicarbonate or sodium bicarbonate type. Chloride and iron are the most objectionable constituents in the ground water of the region. Salty water is known to occur at depths of less than 300 feet in all the physiographic sections of the region, except the Cumberland Mountain section. In general, the chloride content of the ground water becomes higher with increasing depth below drainage, and water that is salty enough to be called a brine eventually will be met in wells drilled deep enough in any part of the region.

Iron is present in noticeable quantities in the water from wells and springs in all formations in the region. Areas in which vadose water drains through beds of black shale or coal, or areas in which acidic mine drainage recharges the ground water probably will have a high iron content. Under these circumstances, the iron-bearing water probably will occur only at shallow depths.

Hydrology of Area 14 Eastern Coal province, Kentucky
Quinones, F., Mull, D. S., York, K. L., and Kendall, V., 1981
Water Resources Investigations 81-137, 145 p.

Hydrology of Area 34, Interior Coal Province, Eastern Region, Kentucky
Quinones, F., York, K. L., and Plebuch, R.
U.S. Geological Survey

Synthetic fuels development, earth science considerations. (Duplicated see Alabama)
Rickert, D. A., Ulman, W. J., and Hampton, E. R., 1979
U.S. Department of Interior/Geological Survey, 45 p.

Floods of April 1977 in the Appalachian Region of Kentucky, Tennessee, Virginia, and West Virginia (Duplicated see Virginia)
Runner, G. S., and Chim, E. D., 1980
U.S. Geological Survey Professional Paper 1028, 43 p.

INDEX TO WATER-QUALITY DATA AVAILABLE FROM THE U.S. GEOLOGICAL SURVEY IN MACHINE-READABLE FORM TO DECEMBER 31, 1972, SOUTHEASTERN REGION
SHOWEN, C. R.; WILLIAMS, O. O.
GEOLOGICAL SURVEY, RESTON, VA. PAPER COPY, $2.25 IN

MICROFICHE. WATER-RESOURCES INVESTIGATIONS 22-73, JUNE 1973. 757 P, 5 FIG, 1 TAB, APPEND.,

Journal Announcement: SWRA0804

THIS REPORT LISTS WATER QUALITY STATIONS OPERATED BY THE GEOLOGICAL SURVEY IN THE SOUTHEASTERN U.S. FOR WHICH DATA ARE AVAILABLE IN MACHINE-READABLE FORM. THE DATA ARE THE RESULTS OF ANALYSES OF WATER SAMPLES AND INDICATE THE CHEMICAL AND PHYSICAL CHARACTERISTICS OF SURFACE WATER AND GROUNDWATER. THE STATIONS ARE LISTED ACCORDING TO STATION NUMBER WITHIN EACH STATE. THE WATER QUALITY DATA ARE IDENTIFIED BY 5-DIGIT PARAMETER CODES AND ARE GROUPED INTO 21 PARAMETER CATEGORIES. THE ANALYTICAL RESULTS FOR ALL SAMPLES IN ANY ONE YEAR ARE THEN GROUPED WITHIN THE PARAMETER CATEGORIES. THE REPORT LISTS THE AVAILABLE RETRIEVAL OPTIONS, THE MACHINE-READABLE OUTPUT OPTIONS, USER CHARGES, AND HOW TO OBTAIN THE DATA. (KNAPP-USGS)

TREE GROWTH

SIGAFOOS, R. S.

GEOLOGICAL SURVEY, WASHINGTON, D.C.

IN: INFLUENCES OF STRIP MINING ON THE HYDROLOGIC ENVIRONMENT OF PARTS OF BEAVER CREEK BASIN, KENTUCKY, 1955-66, GEOLOGICAL SURVEY PROFESSIONAL PAPER 427-C, P C57-C59, 1970. 3 P, 3 FIG, 1 TAB.,

Journal Announcement: SWRA0415

THE NET EFFECT OF STRIP MINING UPON THE FORESTS IN THE CANE BRANCH BASIN, KENTUCKY IS NEGATIVE. THE AREA MINED WAS CLEARED OF TREES AT THE TIME OF MINING, AND AFTER A RECOVERY PERIOD OF 10 YEARS DID NOT SUPPORT THE NUMBER OF TREES THAT A COMPARABLE AREA OF ABANDONED CULTIVATED LAND SUPPORTED. FURTHERMORE, SOME TREES THAT WERE NOT DESTROYED AT THE TIME OF MINING SUBSEQUENTLY DIED, PROBABLY BECAUSE OF BURIAL BY SEDIMENT, AND OTHER TREES MAY HAVE HAD THEIR GROWTH INHIBITED AS A RESULT OF IRRIGATION BY MINE DRAINAGE. (SEE ALSO W71-07935) (KNAPP-USGS)

Floods of December 1978 in Kentucky

Sullavan, J. N.; Quinones, F.; Flint, R. F.

Geological Survey, Louisville, KY. Water Resources Div.

Geological Survey open-file report 79-977, April 1979. 53 p, 15 fig, 6 tab, 4 ref.,

Journal Announcement: SWRA1302

In 1978, severe flooding throughout the State of Kentucky occurred from December 3-10 as a result of intense precipitation from two storms. The storms of December 3-5 and December 7-10 produced record peak discharges in several areas throughout central and eastern Kentucky, resulting in damages of nearly 50 million dollars and the loss of five lives. This report summarizes data collected during the floods by the U.S. Geological Survey, Water Resources Division, and other Federal and State agencies in Kentucky. The data include precipitation, streamflow, and water-quality data (including suspended sediment). Estimates of property damages in selected basins are also provided. The information is preliminary and subject to revisions. (Woodard-USGS)

LOW-FLOW CHARACTERISTICS OF KENTUCY STREAMS
SWISSHELM, R. V. JR
GEOLOGICAL SURVEY, WASHINGTON, D.C.
OPEN-FILE REPORT, 1974, 1 SHEET, 1 MAP.,
Journal Announcement: SWRA0716

LOW-FLOW DATA ARE GIVEN FOR STREAMS THROUGHOUT KENTUCKY. WHERE MORE THAN 10 YEARS OF RECORD ARE AVAILABLE, THE 7-DAY ANNUAL LOW FLOWS ARE USED TO DEFINE A FREQUENCY CURVE. THE DISCHARGE AT 10-YEAR RECURRENCE INTERVAL FROM THAT CURVE IS THE 7-DAY Q10. THIS REPORT PRESENTS THE 7-DAY Q10 DISCHARGE AT 85 CONTINUOUS-RECORD STATIONS AND AT 49 PARTIAL-RECORD STATIONS. THESE VALUES ARE SHOWN ON A MAP ALONG WITH THE STATION NUMBER AND THE DRAINAGE AREA. (KNAPP-USGS)

Water Levels in Observation Wells in Kentucky 1935 Through 1976
Whitesides, D. V.; Kernodle, J. M.; Leist, D. W.
Geological Survey, Louisville, KY. Water Resources Div.; and Geological Survey, Louisville, KY. Geologic Div.
Open-file report 78-129, February 1978. 156 p, 196 fig, 1 tab, 113 ref.,
Journal Announcement: SWRA1117

Hydrographs show water levels in observation wells in Kentucky from 1935 through 1976. The water levels in these wells are measured as part of the national observation well network and in cooperation with the University of Kentucky, Kentucky Geological Survey. The hydrographs are arranged by the five physiograhic regions of Kentucky, alphabetically by county, and in ascending order of latitude. The collection and tabulation of ground-water levels and aquifer data are used to determine short-term changes and long-range trends in water-level fluctuations which reflect the changes in storage within ground-water reservoirs. (Woodard-USGS)

YIELDS AND SPECIFIC CAPACITIES OF BEDROCK WELLS IN KENTUCKY
.WHITESIDES, D.V
GEOLOGICAL SURVEY, LOUISVILLE, KY.
KENTUCKY GEOLOGICAL SURVEY INFORMATION CIRCULAR 21, 1971. 18 P. 5 FIG, 1 TAB, 57 REF.,
Journal Announcement: SWRA0505

SPECIFIC-CAPACITY AND WELL-YIELD DATA ARE PRESENTED FROM CONTROLLED PUMPING TESTS ON 106 SELECTED BEDROCK WELLS IN 41 COUNTIES IN KENTUCKY. OCCURRENCE AND MOVEMENT OF GROUNDWATER IN BEDROCK AQUIFERS ARE DISCUSSED. DEPTHS OF WELLS TESTED RANGE FROM 21 TO 1,015 FEET AND YIELDS RANGE FROM AQUIFERS WILL NEED TO BE DEVELOPED AND UTILIZED AS DEMAND FOR WATER INCREASES ALONG WITH POPULATION GROWTH AND INDUSTRIAL EXPANSION IN KENTUCKY. ADEQUATE GROUNDWATER SUPPLIES FROM BEDROCK WELLS FOR DOMESTIC AND SMALL INDUSTRIAL USE COULD IN ALL PROBABILITY BE DEVELOPED IN SOME AREAS WHICH ARE FAR REMOVED

FROM MAJOR STREAMS AND EXISTING SURFACE RESERVOIRS. THE COST OF INDIVIDUAL WELLS WOULD BE CONSIDERABLY LESS THAN THE COST OF INSTALLING LONG STRETCHES OF PIPELINE, FILTRATION AND TREATMENT FACILITIES, OR BUILDING NEW SURFACE RESERVOIRS. (WOODARD-USGS)

Water Temperatures of Kentucky
Zogorski, J. S.; Kiesler, J. L. Jr
Geological Survey, Louisville, Ky. Water Resources Div.
Water-Resources Investigations 76-86 (Open-File Report), November 1976. 1 sheet, 10 ref.,
Journal Announcement: SWRA1012

The U.S. Geological Survey in cooperation with the Kentucky Geological Survey has been gathering temperature data on streams throughout Kentucky under a number of different programs for several decades. Periodic water temperature observations, which were made at a frequency of approximately once per month during the past 15 years, were analyzed with the aid of a computer program to describe the annual water temperature cycle at sites in the Commonwealth. Shown on a map of Kentucky, at each site of water-temperature collections, are maximum median monthly temperature, minimum median monthly temperature, and annual average temperature. Stream temperatures in Kentucky vary between 0 and 30 degrees Celsius (deg C) during the year. Maximum median monthly water temperatures occur in July and are typically between 23 and 27 deg C, whereas minimum median monthly water temperatures are recorded in January and are useually within the 2 to 6 deg C range. Annual average water temperatures are between 10 and 18 deg C. (Woodard-USGS)

A Compilation of Groundwater Quality Data For Kentucky
Geological Survey, Louisville, KY. Water Resources Div.
Geological Survey Open-File Report 80-685, May, 1980. 963 p, 1 Fig, 8 Tab, 16 Ref. Faust, R. J., Banfield, G. R., and Willinger, G. A., compilers.,
Journal Announcement: SWRA1413

This report provides most of the data in the files of the U.S. Geological Survey on the quality of groundwater in Kentucky. All analyses through 1979 are included except for some special purpose repetitive analyses and some with a very limited number of constituents. County location maps are included with the analyses. These include location, distribution, and density of sampling sites in each county. Most of the data in this report resulted from cooperative studies made with the Kentucky Geological Survey and with other Federal, State, and local agencies. (USGS)

Selected Chemical Quality Characteristics in Streams of Kentucky, 1970-75
Geological Survey, Louisville, KY. Water Resources Div. report), 1980. 1 Sheet, 10 Ref. (Santos, J. F., complier).,

Journal Announcement: SWRA1414

Generalized maps of average dissolved solids, hardness and nitrate concentrations of water in streams throughout Kentucky were prepared from data collected at more than 100 sites from 1970 to 1975. Average dissolved solids concentrations seldom exceed 250 milligrams per liter. Hardness, mostly of calcium magnesium origin, generally ranges from 60 to 180 milligrams per liter. Average nitrate concentrations exceed 2 milligrams per liter at most of the sites. (USGS)

Water Resources Data for Kentucky, published annually since 1975

Geological Survey, Louisville, KY. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22151.

Water resources data for Kentucky consist of records of stage, discharge, and water quality of streams; stage and contents of lakes; and water levels and water quality of wells and springs.

Data collected at various miscellaneous sites is also published. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kentucky. (USGS)

WATER RESOURCES INVESTIGATIONS IN KENTUCKY, 1972

GEOLOGICAL SURVEY, WASHINGTON, D.C.

GEOLOGICAL SURVEY REPORT OF INVESTIGATIONS FOLDER, 1 SHEET, 1972. 5 FIG, 1 MAP.,

Journal Announcement: SWRA0514

THE WATER RESOURCES STUDIES AND INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN KENTUCKY ARE SUMMARIZED. A SELECTED BIBLIOGRAPHY OF MATERIAL CONCERNING THE STATE IS INCLUDED. A LIST IS GIVEN OF STATE AND FEDERAL AGENCIES, COUNTIES, AND CITIES WHO COOPERATE IN DIFFERENT PARTS OF THE PROGRAM. THE HYDROLOGIC DATA NETWORK CONSISTS OF 233 PRIMARY, SECONDARY, AND WATER MANAGEMENT STREAMFLOW STATIONS; 141 GROUNDWATER OBSERVATION WELLS; AND 169 WATER QUALITY OBSERVING SITES. SMALL STATE MAPS SHOW PRINCIPAL SOURCES OF GROUNDWATER, MEAN ANNUAL PRECIPITATION, MEAN ANNUAL RUNOFF, DISCHARGE OF PRINCIPAL RIVERS, AND CHEMICAL TYPE OF SURFACE WATER. A MAP, SCALE APPROXIMATELY 27 MI TO THE INCH, SHOWS BY SYMBOLS, NUMBERS, AND COLLORED OUTLINE THE HYDROLOGIC DATA NETWORK AND INVESTIGATIONS IN KENTUCKY IN JANUARY 1972. (WOODARD-USGS)

Water-Resources Investigations in Kentucky, 1976

Geological Survey, Louisville, Ky. Water Resources Div.

Available from U.S. Geological Survey, Reston, VA 22092. 1976. 1 sheet.,

Journal Announcement: SWRA1018

Water-resources studies and investigations made in Kentucky during 1976 by the U.S. Geological Survey in cooperation with State and local agencies are summarized. A bibliography of selected material concerning these investigations is included. The investigations include collections of basic information through a hydrologic data network, areal hydrologic or interpretative studies, and research projects. The hydrologic data network consists of surface-water stations, groundwater observation wells, and water quality observation sites. Small State maps give a broad picture of variations in some of the hydrologic characteristics pertaining to Kentucky's water resources. A larger map shows the hydrologic data network and investigations in the State. (Woodard-USGS)

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USDAHL-74 Model as a Planning Tool
Fisher, G. T.; Ayars, J. E.; Holtan, H. N.; Nelson, D. L.
Geological Survey, Towson, MD.
Transactions of the American Society of Agricultural Engineers, Vol 22, No 6, p 1347-1352, November-December 1979. 7 Fig, 4 Tab, 7 Ref.,
Journal Announcement: SWRA1314

The University of Maryland version of the USDAHL-74 model was used to simulate the hydrology of Maryland watersheds located in three different geologic provinces. The results of the simulation demonstrated the applicability of the model for use in evaluating the effects of changes in land use on diversified watersheds. (Sims-ISWS)

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia
Herb, W. J.; Shaw, L. C.; Brown, D. E.
Geological Survey, Harrisburg, PA. Water Resources Div.
Geological Survey Open-File Report 81-538 (WRI), September 1981. 92 p, 60 Fig, 22 Tab, 37 Ref, Append.,
Journal Announcement: SWRA1511

Hydrologic data are presented for area 5 of the Eastern Coal Province, the 7,384 square-mile Monongahela River basin in western Pennsylvania, western Maryland, and north-central West Virginia. One hundred thirty-four streams were sampled about three times during the 1979 and 1980 water years for specific conductance, pH, acidity, alkalinity dissolved and total iron, dissolved and total manganese, dissolved sulfate, and dissolved solids. Benthic invertebrate populations were determined and bottom material samples were analyzed for metals. Eleven streams had pH, acidity, alkalinity, total iron, total manganese, and dissolved-sulfate levels indicative of acid-mine drainage. These streams were most common in the Tygart Valley River basin, although indicators of acid-mine drainage were found throughout the Monongahela basin. No benthic invertebrates were found in 25 of 129 streams sampled. Such streams were most common in the Cheat and Tygart Valley River basins. Low flow, mean flow, peak flow, and flow duration data are presented for gaging stations in area 5. Techniques for estimating these data for ungaged sites are presented and referenced. The functions of, and access to, the National Water Data Exchange, WATSTORE, and indexes to water-data activities in coal provinces are presented. (USGS)

HYDROGEOLOGY OF THE FORMATION AND NEUTRALIZATION OF ACID WATERS DRAINING FROM UNDERGROUND COAL MINES OF WESTERN MARYLAND
HOLLYDAY, E. F.; MCKENZIE, S. W.
GEOLOGICAL SURVEY, PARKVILLE, MD.
MARYLAND GEOLOGICAL SURVEY REPORT OF INVESTIGATIONS NO 20,

1973. 50 P, 16 FIG, 8 TAB, 71 REF.,
Journal Announcement: SWRA0718

THE FLOWS FROM 18 UNDERGROUND MINES FOR WHICH MINE MAPS ARE AVAILABLE IN THE BITUMINOUS COAL BASINS OF WESTERN MARYLAND WERE MEASURED, AND WATER SAMPLES WERE COLLECTED FOR DETERMINATION OF 27 MAJOR DISSOLVED CONSTITUENTS AND CHEMICAL PROPERTIES AND 28 MINOR ELEMENTS. NATURAL NEUTRALIZATION IS TAKING PLACE IN THE UNDERGROUND ENVIRONMENT AND THE MOST NEARLY NEUTRALIZED ACID MINE DRAINAGE IS ASSOCIATED WITH FLOW FROM AN UPPER MINE TO A LOWER MINE THROUGH THE INTERVENING ROCK STRATA. (KNAPP-USGS)

GEOLOGIC AND HYDROLOGIC FACTORS BEARING ON SUBSURFACE STORAGE OF LIQUID WASTES IN MARYLAND
OTTON, EDMOND G.
GEOLOGICAL SURVEY, PARKVILLE, MD.
REPORT AVAILABLE FROM MARYLAND GEOLOGICAL SURVEY, LATROBE HALL, JOHNS HOPKINS UNIVERSITY, BALTIMORE, MD. 21218, $2.75. MARYLAND GEOLOGICAL SURVEY REPORT OF INVESTIGATIONS NO 14, 1970. 39 P, 10 FIG, 6 TAB, 57 REF.,
Journal Announcement: SWRA0413

MARYLAND IS DIVIDED INTO 3 MAJOR REGIONS AND THESE, IN TURN ARE DIVIDED INTO 8 MAJOR SUBREGIONS ON THE BASIS OF PHYSIOGRAPHY, GEOLOGY, AND HYDROLOGY AND EACH IS DISCUSSED IN RELATION TO DEEP-WELL INJECTION OF WASTES. IN THE APPALACHIAN REGION, THERE ARE SEVERAL POROUS ZONES THAT MIGHT ACCEPT INJECTED WASTES, AND THICK SEQUENCES OF LOW-PERMEABILITY ROCKS MIGHT FUNCTION AS CONFINING LAYERS. IN SOME PLACES THERE ARE FRESH-WATER ZONES THAT MUST BE CONSIDERED AND IN THE EASTERN PART OF THE WESTERN MARYLAND SUBREGION, THERE IS EXTENSIVE FAULTING THAT MIGHT PERMIT VERTICAL LEAKAGE OF INJECTED WASTES. IN THE PIEDMONT REGION THE HIGHLY METAMORPHOSED AND FRACTURED ROCKS OF THE CATOCTIN MOUNTAIN BELT OFFER FEW OPPORTUNITIES FOR PRACTICABLE INJECTION OF WASTES BECAUSE OF THE LOW PERMEABILITY AND GENERALLY INEFFECTIVE CONFINING LAYERS. IN THE COASTAL PLAIN REGION FACTORS RELATED TO WASTE INJECTION DECISIONS RANGE WIDELY. MOST OF THE AQUIFERS CONTAIN FRESH WATER IN THE INNER COASTAL PLAIN AND THE NUMBER DECREASES SEAWARD. IN THE MIDDLE COASTAL PLAIN, THERE APPEAR TO BE SEVERAL SALINE AQUIFERS BELOW A DEPTH OF ABOUT 2,000 FEET AND IN THE OUTER COASTAL PLAIN THERE ARE MANY. THROUGHOUT THE COASTAL PLAIN REGION THERE ARE EXTENSIVE THICK CONFINING LAYERS. (WOODARD-USGS)

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980
Staubitz, W. W.
Geological Survey, Towson, MD. Water Resources Div.

Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $13.75, Microfiche $3.50. Geological Survey Open-File Report 81-812, August, 1981. 103 p, 1 Fig, 6 Tab, 7 Ref.,

Journal Announcement: SWRA1510

The U.S. Geological Survey is monitoring the water quality of streams within the Eastern Coal Province. This report contains streamflow, water-quality, and biological data collected in the North Branch Potomac River basin and in the Maryland portion of the Youghiogheny and Casselman River basins. Data collected from 64 streams from April 1979 to June 1980 are presented in tables. Other sources of hydrologic information within the study area are also described in the report. (USGS)

Hydrology of Area 6, Eastern Coal Province, Maryland, West Virginia, and Pennsylvania.

Staubitz, W. W., and Sobashinski, J. R.

U.S. Geological Survey.

GEOHYDROLOGIC RECONNAISSANCE OF THE UPPER POTOMAC RIVER BASIN

TRAINER, F. W.; WATKINS, F. A. JR

GEOLOGICAL SURVEY, RESTON, VA.

AVAILABLE FROM SUPT OF DOCUMENTS, GPO, WASHINGTON, DC 20402, PRICE $1.95. WATER-SUPPLY PAPER 2035, 1975. 68 P, 16 FIG, 1 PLATE, 10 TAB, 53 REF.,

Journal Announcement: SWRA0823

THE UPPER POTOMAC RIVER BASIN, IN THE CENTRAL APPALACHIAN REGION IN PENNSYLVANIA, MARYLAND, VIRGINIA, AND WEST VIRGINIA, IS A HUMID TEMPERATE REGION OF DIVERSE FRACTURED ROCKS. THREE GEOHYDROLOGIC TERRANES, WHICH UNDERLIE LARGE PARTS OF THE BASIN, ARE DESCRIBED IN TERMS OF THEIR AQUIFER CHARACTERISTICS AND OF THE MAGNITUDE AND DURATION OF THEIR BASE RUNOFF: (1) FRACTURED ROCK HAVING A THIN REGOLITH, (2) FRACTURED ROCK HAVING A THICK REGOLITH, AND (3) CARBONATE ROCK. CRYSTALLINE ROCK IN THE MOUNTAINOUS PART OF THE BLUE RIDGE PROVINCE AND SHALE WITH TIGHT SANDSTONE IN THE FOLDED APPALACHIANS ARE COVERED WITH THIN REGOLITH. WATER IS STORED IN AND MOVES THROUGH FAIRLY UNMODIFIED FRACTURES. AVERAGE TRANSMISSIVITY (T) IS ESTIMATED TO BE 150 SQ FEET PER DAY, AND AVERAGE STORAGE COEFFICIENT (S), 0.005. CRYSTALLINE AND SEDIMENTARY ROCKS IN THE PIEDMONT PROVINCE AND IN THE LOWLAND PART OF THE BLUE RIDGE PROVINCE ARE COVERED WITH THICK REGOLITH. ESTIMATED AVERAGE VALUES FOR AQUIFER CHARACTERISTICS AR T, 200 SQ FEET PER DAY, AND S, 0.01 . CARBONATE ROCK, IN WHICH FRACTURES HAVE BEEN WIDENED SELECTIVELY BY SOLUTION, ESPECIALLY NEAR STREAMS, HAS ESTIMATED AVERAGE AQUIFER CHARACTERISTICS OF T, 500 SQ FEET PER DAY, AND S, 0.03-0.04. THIS ROCK IS THE MOST EFFECTIVE IN THE BASIN IN TERMS OF WATER SUPPLY AND BASE RUNOFF. ACIDIC MINE-DRAINAGE WATER, LOCAL HIGHLY MINERALIZED GROUNDWATER, AND THE HIGH NITRATE CONTENT OF GROUNDWATER IN SOME AREAS WOULD PROBABLY HAVE LITTLE ADVERSE AFFECT ON THE USE OF GROUNDWATER FOR LOW-FLOW

AUGMENTATION. (WOODARD-USGS)

WATER IN MARYLAND: A REVIEW OF THE FREE STATE'S LIQUID ASSETS
WALKER, PATRICK N.
GEOLOGICAL SURVEY, TOWSON, MD.
MARYLAND GEOLOGICAL SURVEY EDUCATIONAL SERIES NO 2, 1970. 52 P, 28 FIG, 1 MAP.,
Journal Announcement: SWRA0406

THIS REPORT IS INTENDED TO PRESENT TO THE CITIZENS OF MARYLAND AN ACCOUNT OF THE STATE'S WATER RESOURCES. CHAPTERS ARE TITLED AS THOUGH THEY DEALT WITH PARTS OF A FINANCIAL BUDGET BECAUSE WATER RESOURCES MUST BE MANAGED JUST AS FINANCES MUST BE MANAGED. THE CLIMATE OF MARYLAND IS TEMPERATE AND SUBHUMID. AVERAGE ANNUAL TEMPERATURE RANGES FROM ABOUT 48 DEGREES F IN THE MOUNTAINS TO ABOUT 58 DEGREES F IN THE SOUTHERN COASTAL PLAIN. IN A TYPICAL YEAR THE STATE RECEIVES 20,000 BILLION GALLONS OF WATER AS PRECIPITATION OF STREAMFLOW. IN ADDITION, AN ESTIMATED 130,000 BILLION GALLONS OF GROUNDWATER ARE CONTAINED IN THE ROCKS OF THE STATE. MARYLAND'S AVERAGE PRECIPITATION IS ABOUT 42 INCHES PER YEAR. IN GENERAL, PRECIPITATION IS HIGHER IN THE EASTERN AND EXTREME WESTERN PARTS OF THE STATE THAN IT IS IN THE WEST-CENTRAL PART. OF 42 INCHES OF PRECIPITATION EACH YEAR, ABOUT TWO-THIRDS OR 28 INCHES IS LOST TO EVAPOTRANSPIRATION. EACH YEAR ABOUT 14,000 BILLION GALLONS OF WATER LEAVE THE STATE AS STREAMFLOW. SOME 11,000 BILLION GALLONS OF THIS WATER ORIGINATES OUTSIDE OF MARYLAND. MARYLAND IS NOT IN A FLOOD-PLAGUED REGION AND FLOODS ARE RARELY A PROBLEM. MARYLAND'S WATERS ARE GENERALLY OF EXCELLENT QUALITY. (KNAPP-USGS)

Maryland Ground-Water Information: Chemical Quality Data
Woll, R. S.
Geological Survey, Towson, MD. Water Resources Div.
Maryland Geological Survey Water Resources Basic-Data Report No 10, 1978. 126 p, 27 tab, 4 ref.,
Journal Announcement: SWRA1214

Water-quality data from approximately 1600 wells and springs in Maryland are tabulated. The data represent all the ground-water samples collected and analyzed by the U.S. Geological Survey in Maryland during the period 1942-1974. (Woodard-USGS)

Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data
Geological Survey, Towson, MD. Water Resources Div.
Maryland Geological Survey Water Resources Basic Data Report No 11, 1980. 102 p, 5 Fig, 2 Plates, 10 Tab, 21 Ref. (Compiled by Nutter, L. J., Smigaj, M. J., and Knobel, L. L.).,
Journal Announcement: SWRA1501

This report is a compilation of selected water-well records, selected spring records, gas-well records, chemical-quality data, water-use data, coal test-hole records, and surface-water data for Garrett County, Maryland. Included are records of about 1,100 water wells, 120 springs, 210 gas wells, 70 coal test holes, 56 chemical analyses of ground water, surface-water data from 8 continuous-record sites, and miscellaneous measurements from 11 sites. (USGS)

Water Resources Data for Maryland and Delaware, Published annually since 1975.

Geological Survey, Towson, MD. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161.

Water resources data for Maryland and Delaware consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Maryland and Delaware. (USGS)

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Evaluation of Missouri's Coal Resources
Author not provided
Report of Investigations No.48

Missouri possesses coal resources of 31.7 billion tons as determined by mapping and exploration, ranking ninth among the states. Of this total, there are 2.1 billion tons of thick ( 42 inches) coal, 8.5 billion tons of intermediate thickness (28 to 42 inches), and 21.1 billion tons of thin (12 to 28 inches) coal.

Remaining reserves, which total 10.4 billion tons, include 2.1 billion tons of thick coal, 5.0 billion tons of intermediate thickness, and 3.3 billion tons of thin coal.

Remaining reserves are classified according to sulfur content. Data indicate that no significant areas of low-sulfur coal are present in Missouri. Approximately half of the State's coal reserve contains from 4 to 5 percent sulfur, and one-fourth has from 3 to 4 percent sulfur. Less than one-tenth contains less than 3 percent sulfur and the remainder has more than 5 percent.

An estimated additional possible coal resource of 18.2 billion tons is present in untested areas, giving a total coal resource of 49.9 billion tons.

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF THE MISSOURI RIVER ALLUVIUM BETWEEN JEFFERSON CITY AND MIAMI, MISSOURI
EMMETT, L. F.; JEFFERY, H. G.
GEOLOGICAL SURVEY, WASHINGTON, D.C.

REPORT AVAILABLE FOR SALE FROM U S GEOLOGICAL SURVEY, DEPT. OF INTERIOR, WASHINGTON, D.C. - PRICE 50 CENTS. U S GEOLOGICAL SURVEY HYDROLOGIC INVESTIGATIONS ATLAS HA-340, 1 SHEET, 1969. TEXT, 6 FIG, 1 TAB, 1 MAP, 14 REF.,

Journal Announcement: SWRA0318

THIS HYDROLOGIC ATLAS DESCRIBES THE THICKNESS, AREAL EXTENT, AND LITHOLOGY OF THE ALLUVIAL DEPOSITS OF THE MISSOURI RIVER BETWEEN JEFFERSON CITY AND MIAMI, MISSOURI, AND PROVIDES INFORMATION ON THE OCCURRENCE, AVAILABILITY, USE, AND CHEMICAL QUALITY OF THE WATER CONTAINED IN THE ALLUVIAL AQUIFER. FLOOD-PLAIN WIDTHS VARY FROM 1.8 TO 6.4 MILES AND HAVE A TOTAL SURFACE AREA OF APPROXIMATELY 285 SQUARE MILES. THE FLOOD PLAIN IS UNDERLAIN BY ALLUVIUM CONSISTING OF CLAY, SILT, SAND, AND GRAVEL WHICH HAS BEEN DEPOSITED BY THE RIVER. THE SAND AND GRAVEL IN THE LOWER PART OF THE ALLUVIUM IS SATURATED WITH WATER AND FORMS THE ALLUVIAL AQUIFER. THE WATER IN THIS AQUIFER IS IN HYDRAULIC CONNECTION WITH THE MISSOURI RIVER. GRAPHS, TABLES, ILLUSTRATIONS AND A HYDROLOGIC MAP (SCALE 1:125, 000) ARE INCLUDED IN THE ATLAS. (WOODARD - USGS)

RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI RIVER ALLUVIUM BETWEEN MIAMI AND KANSAS CITY, MISSOURI

EMMETT, L. F.; JEFFERY, H. G.

GEOLOGICAL SURVEY, WASHINGTON, D.C.

FOR SALE BY US GEOLOGICAL SURVEY, WASHINGTON, DC - PRICE $0.50. US GEOLOGICAL SURVEY HYDROLOGIC INVESTIGATIONS ATLAS HA-344, 1 SHEET, 1970. TEXT, 3 FIG, 1 TAB, 19 REF.,

Journal Announcement: SWRA0322

THE PURPOSE OF THIS 1-SHEET HYDROLOGIC ATLAS IS TO DESCRIBE THE THICKNESS, AREAL EXTENT, AND LITHOLOGY OF THE ALLUVIAL DEPOSITS ALONG THE MISSOURI RIVER BETWEEN MIAMI AND KANSAS CITY, MO., AND TO PROVIDE INFORMATION ON THE OCCURRENCE, AVAILABILITY, USE, AND CHEMICAL QUALITY OF THE WATER CONTAINED IN THE ALLUVIAL AQUIFER. FLOOD-PLAIN WIDTH VARIES FROM 2 TO 10 MILES AND HAS A TOTAL SURFACE AREA OF APPROXIMATELY 440 SQUARE MILES. UNDERLYING THE FLOOD PLAIN ARE CLAY, SILT, SAND, AND GRAVEL HYDRAULICALLY CONNECTED WITH THE RIVER, CONSTITUTES A LARGE AND PRODUCTIVE AQUIFER, WHICH FOR THE MOST PART IS PRESENTLY UNDERDEVELOPED. ELEVEN CITIES PUMP APPROXIMATELY 13.6 MILLION GALLONS OF WATER PER DAY FROM THE ALLUVIAL AQUIFER IN THIS REACH OF THE RIVER. INDUSTRIAL USE OF GROUNDWATER IS CONFINED TO THE KANSAS CITY AREA AND AMOUNTS TO ABOUT 13 MGD (MILLION GALLONS PER DAY). A ROUGH APPROXIMATION OF WATER USED FOR IRRIGATION IS ABOUT 1.25 MGD; COMBINED MUNICIPLE, INDUSTRIAL, AND IRRIGATION USE AMOUNTS TO ABOUT 28 MGD; 85 PERCENT OF THIS IS PUMPED FROM THE ALLUVIUM BETWEEN KANSAS CITY AND INDEPENDENCE. IRRIGATION WELLS IN THE AREA HAVE REPORTED PUMPING RATES OF AROUND 1,000 GPM, AND SPECIFIC CAPACITIES RANGING FROM 50 TO 150 GPM PER FOOT OF DRAWDOWN. WATER IN ALLUVIUM IN THIS REACH OF THE VALLEY IS A CALCIUM BICARBONATE TYPE, CHARACTERIZED BY A HIGH HARDNESS AND HIGH IRON CONTENT. (KNAPP-USGS)

RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE MISSOURI RIVER ALLUVIUM BETWEEN KANSAS CITY, MISSOURI AND THE IOWA BORDER, (Duplicated see Iowa and Missouri.)

EMMETT, L. F.; JEFFERY, H. G.

GEOLOGICAL SURVEY, WASHINGTON, D.C.

GEOL SURV HYDROL INVEST ATLAS HA-336, 1 SHEET, 1969. TEXT, 8 FIG, 2 MAP, 3 TAB, 18 REF.,

Journal Announcement: SWRA0223

Geochemical Survey of Waters of Missouri

Feder, G. L.

Geological Survey, Lakewood, CO. Water Resources Div.

Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.50. Geological Survey Professional Paper 954-E, 1979. 78 p, 43 Fig, 8 Tab, 30 Ref, Append.,

Journal Announcement: SWRA1317

A reconnaissance geochemical survey of surface and ground waters of the State of Missouri was made to provide epidemiologists with information on the state-wide distribution and variability of chemical constituents. Results from the state-wide sampling program, based on a hierarchical analysis of variance design and randomly chosen sampling sites, show that the concentrations of many chemical constituents in waters of Missouri vary both among and within the major geohydrologic units by statistically significant amounts. The chemical constituents in surface waters show fewer statistically significant differences between geohydrologic units than the ground waters, and in some geohydrologic units the surface water is chemically quite different from the ground water, especially in its trace element content. Where geohydrologic units overlie one another, there may be large differences in the quality of water obtained from closely spaced wells pumping water from different geohydrologic units. Analysis of the ground-water data by Q-mode factor analysis indicates that general chemical character of the waters can be moderately well described in terms of four theoretical water-types. These include (1) a Ca-Mg-HCO3 water with relatively high Cu, (2) a Na-HCO3-C1 water with high K, Li, Al, B, Rb, Sr, F, and Br, (3) a Ca-HCO3-SO4 water with high Fe and Mn, and (4) a water low in total dissolved solids and with low concentrations of trace elements. (Kosco-USGS)

WATER RESOURCES OF NORTHWESTERN MISSOURI
GANN, E. E.; HARVEY, E. J.; BARKS, J. H.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
FOR SALE BY USGS, WASHINGTON, D.C. 20242, PRICE $1.50 PER SET. HYDROLOGIC INVESTIGATIONS ATLAS HA-444, 4 SHEETS, 1973. 26 FIG, 7 TAB, 48 REF.,
Journal Announcement: SWRA0713

A GENERAL SUMMARY IS PRESENTED OF INFORMATION CONCERNING THE OCCURRENCE, AVAILABILITY, USE, AND QUALITY OF WATER IN NORTHWESTERN MISSOURI. ALSO INCLUDED IS A DEFINITION OF PROBLEMS AND POTENTIALS WHICH SHOULD BE CONSIDERED IN THE DEVELOPMENT OF THE WATER RESOURCES OF THE AREA. THIS ATLAS COVERS AN AREA OF APPROXIMATELY 13,000 SQUARE MILES. THE PRINCIPAL SOURCES OF FRESH GROUNDWATER ARE THE ALLUVIUM OF THE MISSOURI RIVER VALLEY, THE ALLUVIUM OF TRIBUTARY VALLEYS, AND THE OUTWASH DEPOSITS IN BURIED BEDROCK VALLEYS. THE EXISTING DRAINAGE NETWORK HAS BEEN DEVELOPED ON THE UNCONSOLIDATED MATERIALS OVERLYING THE BURIED BEDROCK VALLEYS. HYDRAULIC CONNECTION BETWEEN THE ALLUVIUM OF TRIBUTARY VALLEYS AND THE BURIED VALLEYS IS POOR IN MOST AREAS OWING TO RELATIVELY IMPERMEABLE SILT AND CLAY DEPOSITS SEPARATING THE TWO AQUIFERS. HOWEVER, TOWARD THE LOWER END OF THE GRAND RIVER VALLEY THE TWO AQUIFERS MAY BE CONNECTED. ARTESIAN CONDITIONS EXIST IN MOST OF THE BURIED VALLEYS AND IN SOME AREAS IN THE MISSOURI RIVER VALLEY AND TRIBUTARY VALLEYS. WATER FROM BEDROCK AQUIFERS IN NORTHWESTERN MISSOURI IS GENERALLY TOO HIGHLY MINERALIZED FOR MOST USES. THE FLOW OF STREAMS IN NORTHWESTERN MISSOURI IS HIGHLY VARIABLE. THE AVERAGE FLOW FOR A PARTICULAR MONTH MAY VARY FROM YEAR TO YEAR BY A FACTOR OF 1,000. MINIMUM MONTHLY MEAN FLOWS OF MOST STREAMS IN THE AREA OCCURRED DURING

THE SEVERE DROUGHTS OF THE 1930'S AND MID-1950'S. MAXIMUM MONTHLY MEAN FLOWS GENERALLY OCCURRED DURING THE LATE-1920'S, MID-1940'S, AND EARLY-1960'S. FLOW-DURATION CURVES PRESENT GENERAL STREAMFLOW CHARACTERISTICS OF STREAMS IN NORTHWESTERN MISSOURI. GENERALIZED ESTIMATES OF AVERAGE ANNUAL SEDIMENT YIELD ARE USEFUL IN THE PRELIMINARY DESIGN OF WATER RESOURCES PROJECTS. (KNAPP-USGS)

WATER RESOURCES OF WEST-CENTRAL MISSOURI
GANN, E. E.; HARVEY, E. J.; BARKS, J. H.; FULLER, D. L.; MILLER, D. E.
GEOLOGICAL SURVEY, ROLLO, MO.
HYDROLOGIC INVESTIGATIONS ATLAS HA-491, 1974. 4 SHEETS, 46 REF.,
Journal Announcement: SWRA0907

FUTURE DEVELOPMENT IN WEST-CENTRAL MISSOURI IS EXPECTED TO RESULT FROM CONTINUED URBAN EXPANSION AND FROM INCREASING RECREATIONAL USE OF THE FOUR LARGE RESERVOIRS EITHER COMPLETED OR UNDER CONSTRUCTION. KNOWLEDGE OF THE WATER RESOURCES IS NECESSARY IN PLANNING THE USE AND DEVELOPMENT OF THE AREA. THIS ATLAS PRESENTS A GENERAL SUMMARY OF INFORMATION CONCERNING THE OCCURRENCE, AVAILABILITY, USE, AND QUALITY OF WATER. A GENERAL DEFINITION OF EXISTING AND POTENTIAL PROBLEMS RELATED TO THE DEVELOPMENT OF THE WATER RESOURCES IS ALSO INCLUDED. THE ATLAS COVERS APPROXIMATELY 18,000 SQ MI AND INCLUDES ALL OR PARTS OF 35 COUNTIES. THE AREA IS BOUNDED ON THE NORTH BY THE SOUTH EDGE OF THE MISSOURI RIVER FLOOD PLAIN, ON THE EAST BY THE EASTERN DRAINAGE DIVIDES OF THE OSAGE AND NEOSHO RIVER BASINS, AND ON THE WEST AND SOUTH BY THE MISSOURI STATE LINE. WATER RESOURCES OF THE MISSOURI RIVER VALLEY ARE DESCRIBED IN THE PUBLISHED ATLASES SHOWN ON THE INDEX MAP. (WOODARD-USGS)

WATER RESOURCES OF NORTHEASTERN MISSOURI
GANN, E. E.; HARVEY, E. J.; JEFFERY, H. G.; FULLER, D. L.
GEOLOGICAL SURVEY, WASHINGTON, D.C.; AND MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES, ROLLA.
FOR SALE BY U.S. GEOLOGICAL SURVEY, WASHINGTON, D.C. - PRICE $2.00 PER SET, GEOLOGICAL SURVEY HYDROLOGIC INVESTIGATIONS ATLAS HA-372, 4 SHEETS, 1971. TEXT, 25 FIG, 13 MAP, 7 TAB, 22 REF.,
Journal Announcement: SWRA0420

THIS 4-SHEET ATLAS PRESENTS A GENERAL SUMMARY OF INFORMATION CONCERNING THE AVAILABILITY, DISTRIBUTION, AND QUALITY OF WATER IN NORTHEASTERN MISSOURI. ALSO INCLUDED ARE PROBLEMS AND POSSIBILITIES RELATED TO DEVELOPMENT OF THE WATER RESOURCES OF THE AREA. MAPS, TABLES, GRAPHS, AND ILLUSTRATIONS ARE USED TO PRESENT DATA AND INFORMATION FOR SURFACE WATER AND GROUNDWATER HYDROLOGY CONCERNING POLLUTION, IRRIGATION, SEDIMENT TRANSPORT, URBANIZATION, FLOODING, INDUSTRY, AND RECREATION. (WOODARD-USGS)

Summary Appraisals of the Nation's Ground-water

Resources--Missouri Basin Region
Taylor, O. J.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00. Geological Survey Professional paper 813-Q, 1978. 41 p, 12 fig, 3 plates, 8 tab, 53 ref.,
Journal Announcement: SWRA1211

The Missouri Basin Region, about one-sixth of the contiguous United States, utilizes large water supplies for irrigation, industrial, public supply, and rural use. Groundwater resources occur in sand and gravel alluvium, glacial deposits, dune sand, basinfill deposits of sand and gravel, sandstone, siltstone, fractured sandy clay, limestone, and dolomite. Ground water is undeveloped in many areas. Unconsolidated and semiconsolidated aquifers have potential for conjunctive use with surface water, reuse of available supplies, artificial recharge, and salvage of evapotranspiration. Sandstone aquifers have potential for artificial recharge, induced interaquifer leakage, conjunctive use with surface water, and temporary mining of ground water. Limestone and dolomite aquifer have potential for development of a large water supply, induced increase in recharge, and induced interaquifer leakage. Saline ground water occurs throughout the region, but is most abundant in deep aquifers in Wyoming, North Dakota, and South Dakota. Improved water use in the Missouri Basin Region would require a periodic inventory of current supplies in precipitation, streamflow, surface-water storage, and ground water; an awareness of the many possible alternatives to meet demands; and implementation of sound water-management plans. (Woodard-USGS)

Physical Environment and Hydrologic Characteristics of Coal-Mining Areas in Missouri
Vaill, J. E.; Barks, J. H.
Geological Survey, Rolla, MO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-126765, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-67, 1980. 33 p, 12 Fig, 2 Tab, 48 Ref.,
Journal Announcement: SWRA1413

Hydrologic information for the north-central and western coal-mining regions of Missouri is needed to define the hydrologic system in these areas of major historic and planned coal development. This report describes the physical setting, climate, coal-mining practices, general hydrologic system, and the current (1980) hydrologic data base in these two coal-mining regions. Streamflow in both mining regions is poorly sustained. Stream water quality generally varies with location and the magnitude of coal-mining activity in a watershed. Streams in non coal-mining areas generally have dissolved-solids concentrations less than 400 milligrams per liter. Acid-mine drainage has seriously affected some streams by reducing the pH to less than 4.0 and increasing the dissolved-solids concentrations to greater than 1,000 milligrams per liter. This has resulted in fish kills in some instances. Groundwater movement is impeded both laterally and vertically in both mining regions, especially in western Missouri, because of the low hydraulic conductivity of the rocks of Pennsylvanian age. The quality of groundwater varies widely depending on location and depth. Groundwater commonly contains high concentrations of iron and sulfate, and dissolved-solids concentrations generally are greater than 1,000 milligrams per liter. (USGS)

Water Resources Data for Missouri, published annually since 1975

Geological Survey, Rolla, MO. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161.

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981

Geological Survey, Rolla, MO. Water Resources Div.

Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $8.00, Microfiche $3.50. Geological Survey Open-File Report 81-683, August, 1981. 60 p, 2 Fig. (Compiled by Kratzer, W. M.).,

Journal Announcement: SWRA1505

Water-resources investigations of the U.S. Geological Survey in Missouri consist of collecting hydrologic data and making interpretative investigations. The data and the results of the investigations are published or released by either the U.S. Geological Survey or by cooperating agencies. The report describes the data-collection activities and investigations in Missouri for the 1981 fiscal year and provides an extensive list of water-resources references for the State. (USGS)

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1980

Geological Survey, Rolla, MO. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $8.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-1019, August, 1980. 64 p, 2 Fig, 5 Tab, (Compiled by Kratzer, W. M.).,

Journal Announcement: SWRA1412

Water-resources investigations of the U.S. Geological Survey in Missouri consist of collecting hydrologic data and conducting interpretative investigations. The data and the results of the investigations are published or released by either the U.S. Geoloogical Survey or by cooperating agencies. The report describes the data-collection activities and investigations in Missouri for the 1980 fiscal year and provides an extensive list of water-resources references for the State. (USGS)

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TEMPERATURE OF SURFACE WATERS IN MONTANA
AAGAARD, FERN C.
GEOLOGICAL SURVEY, HELENA, MONT.
MONTANA FISH AND GAME DEP REP, 1969. 613 P, 4 FIG, 3 TAB.,
Journal Announcement: SWRA0304

THIS PUBLICATION IS A COMPILATION, IN TABULAR AND GRAPHIC FORM, OF ALL AVAILABLE SURFACE WATER TEMPERATURE DATA IN THE STATE OF MONTANA THROUGH 1965. THE DATA WERE OBTAINED FROM FEDERAL AND STATE AGENCIES, CITIES AND PRIVATE INDUSTRIES. THE REPORT INCLUDES RECORDS OF WATER TEMPERATURES AT 272 SITES ON STREAMS AND LAKES RANGING FROM SPOT OBSERVATIONS AT TIME OF DISCHARGE MEASUREMENTS OR WATER QUALITY SAMPLES TO CONTINUOUS RECORD BY A RECORDING THERMOGRAPH. COPIES ARE AVAILABLE FROM THE MONTANA FISH AND GAME DEPARTMENT, HELENA, MONT. (AAGAARD-USGS)

Ecology and distribution of major diatom ecotypes in the southern Fort Union coal region of Montana
Bahls, L. L., Weber, E. E., and Jarvie, J. O.
U.S. Geological Survey Professional Paper

The Ashland coal field, Rosebud, Powder River, and Custer Counties, Montana, Part 2 of Contributions to economic geology.
Bass, N. W., 1932
U.S. Geological Survey Bulletin 831-B, p. 19-105.

This report describes the stratigraphy of the Fort Union Formation and the geomorphology of about 975 square miles in southeastern Montana. It includes a detailed township-by-township description of the coal resources, and a geologic map at a scale of 1:62,500 showing the outcrop of coal beds and the location of 839 measured coal sections.

Completion and Testing of Madison Limestone Test Well 3, NW1/4SE1/4 Sec. 35, T. 2 N., R. 27 E., Yellowstone County, Montana
Blankennagel, R. K.; Howells, L. W.; Miller, W. R.
Geological Survey, Denver, CO. Water Resources Div.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price: $12.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-528, 1981. 91 p, 16 Fig, 15 Tab, 10 Ref.,
Journal Annuuncement: SWRA1424

Selected intervals in the lower and upper parts of the Mission Canyon Limestone of Mississippian age, and the Amsden Formation and Tensleep Sandstone of Pennsylvanian age, containing water with dissolved-solids concentrations of 3,000 milligrams per liter or less, were perforated through 7-inch casing that was cemented to the wells of the borehole.

Total flow from all perforated intervals after development of each interval by swabbing and flowing was 125 gallons per minute. Total flow increased to 2,900 gallons per minute after acidizing and fracturing each unit through perforations. Radioactive tracer surveys indicate about 65 percent of the flow was from perforations in the upper part of the Mission Canyon Limestone. Based on analysis of data from a step-drawdown test, the values of transmissivity and coefficient of storage considered as most reasonable are 38,000 gallons per day per foot and 0.00002 respectively. Maximum temperature of water, measured at land surface, was 56.6 degrees Celsius. (USGS)

Preliminary Data for Madison Limestone Test Well 3, NW1/4 SE1/4 Sec. 35, T. 2 N., R. 27 E., Yellowstone County, Montana

Blankennagel, R. K.; Howells, L. W.; Miller, W. R.; Hansen, C. V.

Geological Survey, Denver, CO. Water REsources Div.; Geological Survey, Huron, SD. Water Resources Div.; Geological Survey, Billings, MT. Water Resources Div.

Geological Survey open-file report 79-745, June 1979. 186 p, 7 Fig, 3 Plates, 3 Tab, 5 Ref.,

Journal Announcement: SWRA1304

This report provides preliminary data for Madison Limestone test well 3 in Yellowstone County, Mont., including test-well history, geology of the test well, hydrologic testing, and geochemistry. It also discusses the preliminary results and future testing. The test well was drilled as part of the study to determine the water-resource potential of the Madison Limestone and associated rocks to meet future water needs in a 188,000-square-mile region that includes the coal-rich area of the Northern Great Plains. Drilling and testing were designed to yield a maximum of stratigraphic, structural, geophysical, and hydrologic information. (Woodard-USGS)

Preliminary data for Madison Limestone test well No. 2, SE 1/4 SE 1/4 sec. 18, T.1 N., R.54 E., Custer County, Montana

Brown, D. L., Blankennagel, R. K., Husby, J. F., and Lee, R. W., 1977

U.S. Geological Survey Open-File Report 77-863, 135 p.

This report provides the preliminary data for the Madison Limestone test well 2 including test-well history, geology of the test well, hydrologic testing, and geochemistry. It also discusses the preliminary results and future testing plans.

The test well was drilled as part of the study to determine the water-resource potential of the Madison Limestone and associated rocks to meet future water needs in a 188,000-square-mile region that includes the coal-rich area of the Northern Great Plains. Drilling and testing were designed to yield a maximum of stratigraphic, structural, geophysical, and hydrologic information.

The test well was drilled in the SE 1/4 SE 1/4 sec. 18, T. 1 N., R. 54 E., Custer County, Montana, to a depth of 9,378 feet below land surface. The well is cased with 13-3/8-inch casing from land surface to 4,661 feet and 9-5/8-inch casing from 4,519 to 6,487 feet below land surface. It is an 8-1/2-inch-diameter open hole from 6,487 feet to 8,422 feet. The well is plugged below that depth by two cement plugs--one from 9,378 to 9,084 feet and the other from 8,884 to 8,422 feet. The well is so constructed that additional hydrologic tests and geophysical logs can be made at a later date.

Nineteen cores were taken from selected intervals totaling 754 feet; 722.4 feet of core was recovered. The cores were photographed, slabbed, and plugged, and selected parts were tested for density, porosity, and vertical and horizontal permeability. Gamma and density scans of the cores were made, and thin sections are being prepared for detailed examination.

Seventeen conventional drill-stem tests and packer-swabbing tests were attempted, 13 of which give clues to the pressure heads of water in the intervals tested. Water samples were obtained during 10 of the tests, 7 of which were flow tests.

Water from the open-hole part of the well had a shut-in pressure of 333 pounds per square inch and flowed about 44 gallons per minute. The temperature of the water, measured at the surface, was about 48 degrees Celsius.

With the possible exception of the Dakota Sandstone, no major potential sources of ground water were found in the test well. Also, no freshwater (less than 1,000 milligrams per liter dissolved solids) was found in any of the zones tested in the well. Water salinities ranged from about 2,000 to 46,500 milligrams per liter dissolved solids.

Additional geophysical logs and tests will be made in the test well during the summer and fall of 1977. The logs may include televiewer, gamma spectrometer, trace ejector, and spinner-surveys. A vertical seismic profile will be made in the well in August.

The Coalwood coal field, Powder River County, Montana
Bryson, R. P., 1952
U.S. Geological Survey Bulletin 973-B, p. 23-106.

This report contains a geologic map at a scale of 1:63,360 for a large area along the crest and western flank of the Black Hills uplift. Shown on the map are the outcrop areas of 30 coal beds. Also included are analyses of two coal samples; measured stratigraphic sections for the 1,320 ft of exposed Hell Creek and Fort Union Formations; a table of fossil-collection sites; and diagrams showing correlations, ranges in thickness, and average intervals between coal beds. The text describes the stratigraphy of the geologic units and the characteristics of the coal beds.

A township-by-township discussion of coal resources and estimated reserves is accompanied by 264 graphic coal sections.

Geology of Moorhead coal field, Powder River and Rosebud counties, Montana
Bryson, R. P., and Bass, N. W., 1973
U.S. Geological Survey Bulletin 1338, 116 p.

This report contains a geologic map (2 sheets) at a scale of 1:63,360 of the Hell Creek, Fort Union, and Wasatch Formations for a large area along the northeast flank of the Powder River Basin. Shown on the map are the outcrop and burned area for 33 coal beds more than 2 ft thick. Also included are analyses of 10 coal samples, measured stratigraphic sections for the entire 2,250-ft column of exposed rocks in the map area, and a diagram showing the stratigraphic positions of the coal beds. The text describes the major structural features and stratigraphy of the map units. A township-by-township discussion of the coal resources and reserves is accompanied by more than 1,000 graphic coal sections.

Geology of certain lignite fields in eastern Montana, in Contributions to economic geology, 1910--Part II
Calvert, W. R. 1912.
U.S. Geological Survey Bulletin 471, p. 187-201.

This report is the introductory report for the Baker, Terry, Glendive, Sidney, and Culbertson lignite field reports that are in U.S. Geological Survey Bulletin 471. The report mostly describes the stratigraphy of the area and includes descriptions of the Pierre Shale, Lance Formation equivalent, and Fort Union Formation. Included are lists of fossils and three sections of rocks with lithologic descriptions.

Potential effects of surface coal mining on the hydrology of the Cook Creek area, southeastern Montana
Cannon, M. R.,
U.S. Geological Survey Water-Resources Investigations Open-File Report 82-681, 30 P.

The Cook Creek area of the Ashland coal field contains large reserves of Federally owned coal that have been identified for potential lease sale. A hydrologic study has been conducted in the potential lease area to describe existing hydrologic systems and to assess potential impacts of surface coal mining on local water resources.

Hydrogeologic data collected from wells, springs, and drill holes indicate that shallow aquifers exist within the Tongue River Member of the Fort Union Formation (Paleocene age) and within valley alluvium (Pleistocene and Holocene age). Shallow aquifers within the Tongue River Member include coal beds, clinker, and lenses of sandstone and siltstone. The Knobloch coal bed, a principal shallow aquifer used for stockwatering in the area, averages about 55 feet in thickness and is completely saturated throughout most of its extent. Coarse alluvial deposits are the most productive aquifers and are a major source of stock water in the Cook Creek basin.

Surface-water resources are limited to the upstream reach of Cook Creek, which flows intermittently. The downstream reach of Cook Creek, plus all other small drainages that originate in the study area, are ephemeral.

Mining of the Knobloch and Sawyer coal beds would remove two alluvial springs, one bedrock spring, and two wells, which are all used for watering of livestock. The potentiometric surface within ,the Knobloch coal aquifer and the alluvial aquifer in the downstream part of the Cook Creek basin would be lowered during mining. Lowered water levels in these aquifers might substantially affect water levels in five wells outside the mine boundary. After mining, water in the alluvial aquifer downgradient from the mine area might show a long-term degradation in quality as a result of leaching of soluble salts from overburden materials used to backfill mine pits. Although mining would alter the existing hydrologic systems and remove several springs and shallow wells, alternative ground-water supplies are available that could be developed to replace those lost by mining.

Potential effects of surface coal mining on the hydrology of the Snider Creek area, Rosebud and Ashland coal fields, southeastern Montana

Cannon, M. R.

U.S. Geological Survey Water-Resources Investigations 82-4051, 28 p.

The Snider Creek area of the Rosebud and Ashland coal fields contains strippable reserves of Federal coal that have been identified for potential lease sale. A hydrologic study has been conducted in the potential lease area to describe the existing hydrologic systems and to assess potential impacts of surface coal mining on local water resources.

Hydrogeologic data collected from stock wells, observation wells, and drill holes show that shallow aquifers exist within the Tullock, Lebo Shale, and Tongue River Members of the Fort Union Formation (Paleocene age) and within valley alluvium (Pleistocene and Holocene age). Most of the wells in the area are completed in the basal part of the Tongue River Member or in the upper part of the Lebo Shale Member and are used for watering of livestock. Small stock reservoirs are the primary source of surface water; Snider Creek and all other streams that originate in the area are ephemeral.

The Terrett coal bed of the Tongue River Member is the primary coal bed of the area and is located above the water table. Mining of the Terrett coal bed would destroy one stock well and several small reservoirs. Four other wells near the coal outcrop might be destroyed by mining. Alternative ground-water supplies are available to replace those lost by mining. Degradation of the quality of ground water, caused by the leaching of soluble salts from mine spoils, is not anticipated.

Selected Hydrologic and Climatologic Data from the Prairie Dog Creek Basin, Southeastern Montana, Water Year 1980

Cary, L. E.; Johnson, J. D.

Geological Survey, Helena, MT. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $10.00 in paper copy, $3.50 in microfiche. Open-File Report 82-273, March 1982. 74 p, 2 Fig, 42 Tab, 4 Ref.,

Journal Announcement: SWRA1601

Hydrologic and climatologic data are being collected in a 25-square-mile (65-square-kilometer) basin in southeastern Montana to provide a base for development, calibration, and verification of a precipitation-runoff model. The study area and data-collection stations within the area are shown on a map. A summary of data collected at each station during the second year, beginning in October 1979, is provided in tables. The data include precipitation, snow depth and water content, air temperature, relative humidity, wind speed and direction, solar radiation, soil temperature and moisture, stream discharge, chemical analyses of water, and suspended sediment. (USGS)

Selected Hydrologic and Climatologic Data from the Prairie Dog Creek Basin, Southeastern Montana, Water Year 1979

Cary, L. E.; Johnson, J. D.

Geological Survey, Helena, MT. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $10.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-412, 1981. 73 p, 1 Fig, 23 Tab, 3 Ref.,

Journal Announcement: SWRA1420

Hydrologic and climatologic data are being collected in a 19-square-mile (49-square-kilometer) basin in southeastern Montana to provide a base for development, calibration, and verification of a precipitation-runoff model. The study area and data-collection stations within the area are shown on a map. A summary of data collected at each station during the first year, beginning in October 1978, is provided in tables. The data include precipitation, snow depth and water content, air temperature, relative humidity, wind run, solar radiation, soil temperature and moisture, stream discharge, chemical analyses of water, and suspended sediment. (USGS)

The coal resources of McCone County, Montana
Collier, A. J., and Knechtel, M. M., 1939
U.S. Geological Survey Bulletin 905, 80 p.
This report contains a generalized stratigraphic section of the exposed rocks from the top of the Bearpaw Shale through the Tongue River Member of the Fort Union Formation, a regional-scale structure map, a geologic map of the area at a scale of 1:125,000, and three geologic sections. The text describes the general structural features and the stratigraphy of the map units although formation terminology has since been revised. A lengthy township-by-township discussion of coal resources for the county is accompanied by 531 graphic sections of 11 coal beds.

The Flaxville gravel and its relation to other terrace gravels of the northern Great Plains in Shorter contributions to general geology 1917
Collier, A. J., and Thom, W. T., 1918
U.S. Geological Survey Professional Paper 108, p. 179-184.

Coal resources of Montana
Combo, J. X., Brown, D. M., Pulver, H. F., and Taylor, D. A., 1949
U.S. Geological Survey Circular 53, 28 p.

Three deposits of strippable lignite west of the Yellowstone River, Montana
Culbertson, W. C., 1954
U.S. Geological Survey Bulletin 995-H, p. 293-332.
This report describes three lignite deposits that are suitable for strip mining in an area of about 700 square miles. The lignite is mapped on the basis of overburden in categories of less than 60 ft, 60 to 90 ft, and 90 to 120 ft. Nine analyses of lignite samples are given. A columnar section shows the stratigraphic position and correlation of lignite beds. Thirty-seven coal sections were measured. Included are three maps that show the coal deposits, the amount of overburden, and the coal-section sites.

Measurements of Discharge, Gain or Loss in Flow, and Chemical Quality of the Poplar and Redwater Rivers, Northeastern Montana, October 24-25, 1979
Dodge, K. A.; Levings, G. W.
Geological Survey, Helena, MT. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $2.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-1210, November 1980. 16 p, 2 Fig, 3 Tab.,

Journal Announcement: SWRA1414

Discharge, specific conductance, and water temperature were measured at 37 sites on the Poplar and Redwater Rivers in northeastern Montana on October 24-25, 1979, to provide data on the interaction between surface-water and groundwater systems. Streamflow gains or losses were computed for those stream reaches not significantly affected by irrigation. Water samples were collected at 17 of the sites for detailed chemical-quality analysis. The tabulated data provide an areally broad data base of concurrent base-flow conditions. (USGS)

Geohydrology of the Madison and associated aquifers in parts of Montana, North Dakota, South Dakota, and Wyoming

Downey, Joe S., 1980

U.S. Geological Survey, Montana, 108 p.

Base Flow and Chemical Quality of Streams in the Northern Great Plains Area, Montana and Wyoming, 1977-78.

Druse, Stanley A., Dodge, Kent A., and Hotchkiss, W. R.

U.S. Geological Survey Water-Resources Investigations Open-File Report 81-692.

Base-flow discharge and chemical-quality measurements were made at 233 selected sites on streams during October-November 1977, August-September 1978, and October 1978 to provide data on the interaction between surface- water and ground-water systems in the northern Great Plains area of Montana and Wyoming. The tabulated data provide an areally broad data base of con-current base-flow conditions.

Streamflow gains or losses were computed for stream reaches not significantly affected by irrigation. On October 17, 1978, the change in flow of the upper Powder River between Sussex and Arvada, Wyoming, was a loss of 14 cubic feet per second. On the same date, the change in flow of the lower Powder River between Arvada, Wyoming, and Moorhead, Montana, was a gain of 6 cubic feet per second. Except for August-September 1978, major subbasins showed little significant differences in water discharge, chemical character, or dissolved-solids concentrations.

Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana. (Duplicated see North Dakota)

Emerson, D. G.

Geological Survey, Bismarck, ND. Water Resources Div. Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $4.25, Microfiche $3.50. Geological Survey Open-File Report 81-678, June, 1981. 28 p, 6 Fig, 7 Tab, 11 Ref.,

Journal Announcement: SWRA1509

Geochemistry of ground waters in the Powder River coal region in 4th Annual Progress Report in Geochemical Survey of the Western Energy Regions
Feder, G. L., Lee, R. W., Busby, J. F., and Saindon, L. G., 1977
U.S. Geological Survey Open-File Report 77-872, p. 173-179.

Water Resources of Shallow Aquifers in the Upper Poplar River Basin, Northeastern Montana
Feltis, R. D.
Geological Survey, Helena, MT. Water Resources Div.
Geological Survey Water-Resources Investigations 79-51 (open-file report), June 1979. 23 p, 3 Fig, 2 Plates, 5 Tab, 6 Ref.,
Journal Announcement: SWRA1304
The aquifer system studied in the upper Popular River basin in Montana ranges in age from Late Cretaceous to Holocene. Most wells obtain water from the Paleocene Fort Union Formation or younger rocks. The potentiometric surface of the Fort Union and overlying rocks indicates movement of water from the high interstream areas toward principal stream valleys. Recharge is principally through sand and gravel deposits of the Flaxville Formation, which occur as large terrace remnants, and the Wiota Gravel. Water in these formations locally recharges the underlying Fort aquifers are of the sodium bicarbonate, magnesium bicarbonate, or calcium bicarbonate type. The range in dissolved-solids concentration for the measurements of the Poplar River and East Fork Poplar River from the international boundary to the south edge of the study area in October 1977 showed a net gain of 2.84 cubic feet per second from a total flow of 11.7 cubic feet per second. This gain is discharge of water from the alluvium to the rivers. (Woodard-USGS)

Selected Hydrogeologic Data from Southern Sweet Grass County, South-Central Montana
Feltis, R. D.; Wood, Wayne A.
Geological Survey, Helena, MT. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $3.25 in paper copy, $4.00 in microfiche. Open-File Report 82-265, February 1982. 12 p, 2 Fig, 1 Plate, 3 Tab.,
Journal Announcement: SWRA1601
Selected hydrogeologic data from Sweet Grass County south of the Yellowstone River have been compiled to show baseline ground-water conditions. Included are records from a 1981 onsite inventory of 94 water wells and 30 springs. Chemical analyses of water show the major cation and anion

concentrations for 40 wells and 14 springs. Concentrations of 17 trace elements in water from 12 of the wells and 9 of the springs were determined by an argon coupled emission spectrometer. (USGS)

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana
Ferrieria, R. F.
Geological Survey, Helena, MT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-137696, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-61, October, 1981. 21 p, 5 Fig, 5 Tab, 13 Ref.,
Journal Announcement: SWRA1510

Streamflow characteristics of drainage basins within the Forst Union coal region of southeastern Montana were estimated to provide premining data for evaluating the future effects of mining on the environment. Estimated annual mean streamflow at 22 data-collection stations for water years 1975-77 ranged from 0 to 887 cubic feet per second. These estimates are based on miscellaneous-streamflow records at each station and continuous-streamflow records from other stations in the study area. Estimated mean annual streamflow for a 10-year period (water years 1968-77) ranged from 0 to 572 cubic feet per second. These long-term estimates were based on data from stations in the surrounding area having continuous-streamflow records. Estimates mean annual runoff in inches for selected drainage basins within the study area showed no discernible pattern. Many of the drainage basins had a mean annual runoff of less than 0.60 inch; the maximum observed mean annual runoff was 4.45 inches. (USGS)

Restored stratigraphic cross sections and coal correlations in the Tongue River Member of the Fort Union Formation, Powder River area, Montana
Flores, R. M., 1979
U.S. Geological Survey Miscellaneous River Studies Map MF-1127, 2 sheets.

Geology and coal resources of the Foster Creek coal deposit, eastern Montana
Gilmour, E. H., and Williams, L. A., 1969
Montana Bureau of Mines and Geology Bulletin 73, 9 p.

WATER RESOURCES OF THE YELLOWSTONE RIVER VALLEY, BILLINGS TO PARK CITY, MONTANA
GOSLING, A. W.; PASHLEY, E. F. JR
GEOLOGICAL SURVEY, WASHINGTON, D.C.
HYDROLOGIC INVESTIGATIONS ATLAS HA-454, 2 SHEETS, 1973. 7 FIG,

2 MAP, 20 REF.,

Journal Announcement: SWRA0622

THIS 2-SHEET ATLAS DESCRIBES THE WATER RESOURCES OF THE YELLOWSTONE RIVER VALLEY FROM PARK CITY TO BILLINGS, MONTANA, WITH PARTICULAR EMPHASIS ON THE ADEQUACY AND SUITABILITY OF THE WATER SUPPLY FOR THE PROJECTED GROWTH OF THE GREATER BILLINGS AREA. THE LARGEST QUANTITY OF GOOD QUALITY GROUNDWATER INTO THE CRETACEOUS ROCKS YIELD ONLY SMALL QUANTITIES OF POOR QUALITY WATER, EXCEPT FOR THE JUDITH RIVER FORMATION AND THE EAGLE SANDSTONE, WHICH YIELD SMALL QUANTITIES OF WATER OF FAIR QUALITY. THE ANNUAL WATER REQUIREMENT OF WATER USERS RANGES FROM 200,000 TO ALMOST 400,000 ACRE-FEET PER YEAR. AGRICULTURAL CONSUMPTION IS 180,000 TO 360,000 ACRE-FEET PER YEAR, MUNICIPAL CONSUMPTION IS ABOUT 20,000 ACRE-FEET PER YEAR, AND INDUSTRIAL AND COMMERCIAL CONSUMPTION IS ABOUT 5,000 ACRE-FEET PER YEAR. THE YELLOWSTONE RIVER SUPPLIES ABOUT 98% OF WATER USED; THE REMAINING 2% IS SUPPLIED FROM GROUNDWATER. BILLINGS IS GROWING STEADILY AND THE POPULATION MAY EXCEED 100,000 IN THE 1980'S. THE WATER REQUIREMENT OF THE CITY IS NOT EXPECTED TO RISE ABOVE 30,000 ACRE-FEET PER YEAR IN THE FORESEEABLE FUTURE. (WOODARD-USGS)

Shallow Ground water in Selected Areas in the Fort Union Coal Region.

Ground-water Subgroup of Water Work Group, Northern Great Plains Resource Program, 1974.

U.S. Geological Survey Open-File Report 74-371, 132 p.

GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA

HAMILTON, L. J.; PAULSON, Q. F.

U. S. GEOLOGICAL SURVEY.

U S GEOL SURV WATER-SUPPLY PAP 1876, 39 P, 1968. 7 FIG, 1 PLATE, 6 TAB, 19 REF.,

Journal Announcement: SWRA6804

THE ONLY ECONOMIC SOURCES OF GROUNDWATER IN LARGE AREAS OF THE LOWER BIGHORN VALLEY, MONTANA, ARE 6 TERRACE GRAVEL DEPOSITS 100-200 FT APART IN ALTITUDE AND ABOUT 30 FT THICK. THE BEDROCK CUT BY THE RIVER IS VERY THICK, RELATIVELY IMPERMEABLE CRETACEOUS SHALE. IN 3 PLACES SANDSTONE AQUIFERS WITH SOFT, MODERATELY TO HIGHLY MINERALIZED WATER WITH LARGE AMOUNTS OF NA ARE AT MODERATE DEPTHS. GROUNDWATER IN THE ALLUVIUM IS HARD, AND IN THE IRRIGATED LOWLANDS IT IS HIGHLY MINERALIZED WHERE DRAINAGE IS SLOW AND EVAPOTRANSPIRATION IS GREAT. RECHARGE BY IRRIGATION WATER AND SEEPAGE FROM IRRIGATION CANALS HELP MAINTAIN HIGH WATER LEVELS. ALLUVIAL WELLS YIELD UP TO 100 GPM. SOME ALLUVIAL AQUIFERS ARE CONFINED BY RELATIVELY IMPERMEABLE SURFICIAL SILT AND CLAY DEPOSITS AND HAVE A SLIGHT ARTESIAN PRESSURE WHICH KEEPS THE WATER LEVEL CLOSE TO THE SURFACE AND CAUSES WATERLOGGING AND ALKALI DEPOSITION PROBLEMS. DRAINAGE DITCHES MUST BE USED TO PREVENT WATERLOGGING IF ANY

IRRIGATION OF HIGHER TERRACES IS ATTEMPTED. (KNAPP-USGS)

The Glendive lignite field, Dawson County, Montana, in Contributions to economic geology, 1910--Part II
Hance, J. H., 1912
U.S. Geological Survey Bulletin 471, p. 271-283.

This report consists of a township-by-township description of the occurrence of coal in the Fort Union Formation for the areas delineated by Tps. 13 and 14 N., Rs. 53 to 60 E.; Tps. 15 and 16 N., Rs. 53 to 58 E; and T. 17 N., Rs. 53 to 57 E. The physical properties and chemical composition are given for six coal samples. Included is a map at a scale of 1:125,000 showing geology and the outcrops of coal and burned areas.

The Terry lignite field, Custer County, Montana, in Contributions to economic geology, 1910--Part II
Herald, F. A., 1912
U.S. Geological Survey Bulletin 471-D, p. 227-270

This report consists of a township-by-township description of the occurrence of coal in the Fort Union Formation for a strip of land in Tps. 9 to 12 N. that is bounded on the west by the Powder and Yellowstone Rivers and on the east by the State line. Included are stratigraphic sections of the Lance Formation equivalent and Fort Union Formation as well as descriptions of 21 coal sections. One coal sample was analyzed. Included is a map at a scale of 1:125,000 showing geology, coal outcrops, and burned areas.

WATER RESOURCES OF THE NORTHERN CHEYENNE INDIAN RESERVATION AND ADJACENT AREA, SOUTHEASTERN MONTANA
HOPKINS, W. B.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
FOR SALE BY USGS, WASHINGTON, D.C. 20242 PRICE $1.00 PER SET. HYDROLOGIC INVESTIGATIONS ATLAS HA-468, 1973. 2 SHEETS, 2 MAPS, 2 TAB, 6 REF.,
Journal Announcement: SWRAU708

WATER RESOURCES OF THE NORTHERN CHEYENNE INDIAN RESERVATION, MONTANA, AND ADJACENT AREA ARE DESCRIBED IN TERMS OF SOURCES, AMOUNTS AVAILABLE, AND QUALITY. THE STUDY AREA INCLUDES ABOUT 2,500 SQUARE MILES OF THE UNGLACIATED MISSOURI PLATEAU PART OF THE GREAT PLAINS PROVINCE IN SOUTHEASTERN MONTANA. PRESENT WATER USE IS SMALL AS ONLY ABOUT 2,500 PEOPLE LIVE ON THE RESERVATION, AND APPROXIMATELY 1,000 MORE LIVE ON RANCHES IN THE REST OF THE AREA. THE AVERAGE ANNUAL PRECIPITATION FROM 1960 THROUGH 1968 WAS 14.47 INCHES. WELLS AND SPRINGS YIELD WATER FOR DOMESTIC OR STOCK SUPPLIES FROM THE ALLUVIUM IN STREAM VALLEYS; FROM CLINKER BEDS, SANDSTONE AND COAL BEDS IN THE TONGUE RIVER MEMBER OF THE FORT UNION FORMATION;

AND FROM SANDSTONE BEDS IN THE HELL CREEK FORMATION. WELLS THAT WOULD YIELD MORE THAN 50 GPM WOULD BE LIMITED TO THE ALLUVIUM ALONG THE PERENNIAL STREAMS. MOST OF THE REPORT AREA IS DRAINED BY THE TONGUE RIVER AND ITS TRIBUTARIES. THE CONCENTRATION OF DISSOLVED SOLIDS IN THE TONGUE RIVER IN

Water-Resources Data for Deep Aquifers on Eastern Montana
Hopkins, W. B.
Geological Survey, Helena, Mont. Water Resources Div.
Water-Resources Investigation 76-40 (open-file report), June 1976. 37 p, 6 fig, 5 tab, 64 ref.,
Journal Announcement: SWRA1006

Water from aquifers of Mesozoic and Paleozoic age in eastern Montana is little used. This report presents maps and tables to assist in the evaluation of the water in terms of possible utility. In the southern third of eastern Montana water from the Madison Group or from the Tensleep Sandstone contains less than 2,000 milligrams per liter dissolved solids and is available in amounts of as much as 3,700 gallons per minute (230 liters per second) from individual wells. Elsewhere, dissolved-solids concentrations of water from Mesozoic and Paleozoic aquifers commonly exceed 1,000 milligrams per liter, well yields range from 5 to about 1,500 gallons per minute (0.3 to 95 liters per second), and well depths generally are greater than 1,500 feet (460 meters). (Woodard-USGS)

A METHOD FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN MONTANA
JOHNSON, M. V.; OMANG, R. J.
GEOLOGICAL SURVEY, HELENA, MONT.
OPEN-FILE REPORT 75-650, JANUARY 1976. 35 P 6 FIG, 3 PLATES, 1 TAB, 14 REF, APPEND.,
Journal Announcement: SWRA0911

METHODS ARE PROVIDED FOR ESTIMATING FLOOD CHARACTERISTICS AT MOST NATURAL FLOW SITES ON RURAL STREAMS IN MONTANA. FLOOD DATA AND RELATED INFORMATION FOR MANY GAGED SITES ON MONTANA STREAMS ALSO ARE PRESENTED. FREQUENCY CURVES ARE INCLUDED FOR 442 GAGED SITES AS DEFINED BY LOG-PEARSON TYPE III ANALYSIS. TO ALLOW ESTIMATES AT UNGAGED SITES, MATHEMATICAL EQUATIONS RELATE THE 2-, 5-, 10-, 25, 50-, AND 100-YEAR FLOOD MAGNITUDES TO BASIN CHARACTERISTICS. DRAINAGE AREA, MAIN CHANNEL SLOPE, AND MEAN ANNUAL PRECIPITATION WERE THE MOST SIGNIFICANT ESTIMATING VARIABLES. EQUATIONS PRESENTED ARE LIMITED TO USE ON STREAMS WITH DRAINAGE AREAS FROM ABOUT 0.1 PRECIPITATION FROM 10 TO 100 IN. NOMOGRAPHS PROVIDE A SIMPLE GRAPHICAL MEANS OF SOLVING THE ESTIMATING RELATIONS, AND ILLUSTRATIVE EXAMPLES ARE PRESENTED. (WOODARD-USGS)

Evaluation and Correlation of Water-Quality Data for the

North Fork Flathead River, Northwestern Montana

Knapton, J. R.

Geological Survey, Helena, MT. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22151 as PB-292 702, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-111, November 1978. 95 p, 22 fig, 10 tab, 18 ref.,

Journal Announcement: SWRA1214

This report is a compilation and evaluation of water-quality measurements that have been made by the U.S. Geological Survey at two stations on the North Fork Flathead River in Montana. Historical streamflow records show an annual mean daily discharge of 3,010 cubic feet per second near the mouth--a threefold increase compared to discharge at the international boundary. The chemical character of the water is dominated by calcium and magnesium cations and the bicarbonate anion. Base flow, in contrast to high flows from runoff, is characterized by higher dissolved constituents and lower concentrations of suspended sediment. The several lakes that contribute water throughout the middle and lower drainage have a dampening effect on both streamflow and constituent concentrations. Using the available data and computer techniques, regression equations were developed between certain water-quality variables. (Woodard-USGS)

Quality of Streams in the Bull Mountains Region, South-Central Montana

Knapton, J. R.

Geological Survey, Helena, MT. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-238361, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-2, 1982. 50 p, 5 Fig, 9 Tab, 21 Ref.,

Journal Announcement: SWRA1605

In October 1977, water-quality monitoring stations were established on five small streams that drain the Bull Mountains and also on the Musselshell River to document present water-quality conditions in a coal area of south-central Montana. Relatively static water-quality conditions exist throughout the annual flow cycle on the small streams but water quality varies with time on the Musselshell River. The near absence of surface runoff in the Bull Mountains during the study and the dominance by the base-flow component account for stability of water quality in the small streams. High-mountain runoff coupled with storms and prairie runoff impact the base flow of the Musselshell River. Bicarbonate and sulfate were the principal anions and are present in nearly equal proportions in all small streams. Except for West Parrot Creek, magnesium was the most dominant cation. West Parrot Creek, which consistently contained the smallest levels of dissolved solids, had sodium rather than magnesium as the principal cation. Fattig Creek was highest in dissolved solids with an approximate concentration range of 900 to 2,100 milligrams per liter. Suspended-sediment discharge in the streams was relatively small; no stream exceeded 0.32 ton per day. The Musselshell River had dissolved solids concentrations that ranged from about 450 milligrams per liter during spring runoff to 1,800 milligrams per liter during periods of base flow. The sodium sulfate-type water, which is common during base flow, is diluted during runoff with water having principal ions of calcium, magnesium, and bicarbonate. Suspended-sediment loads ranged from 0.56 to 37,300 tons per day and correlated directly to stream discharge. (USGS)

RESULTS OF PHYTOPLANKTON SAMPLING AT NATIONAL STREAM QUALITY ACCOUNTING NETWORK STATIONS IN MONTANA--1975 WATER YEAR
KNAPTON, J. R.; BOCHY, B. M.
GEOLOGICAL SURVEY, HELENA, MONT.
OPEN-FILE REPORT 76-219, MARCH 1976. 27 P, 2 FIG, 13 TAB, 4 REF, APPEND.,
Journal Announcement: SWRA0917

TWELVE NATIONAL STREAM QUALITY ACCOUNTING NETWORK STATIONS WERE OPERATED IN MONTANA DURING THE 1975 WATER YEAR (OCT. 1, 1974-SEPT. 30, 1975). THE NETWORK WAS ESTABLISHED TO ACQUIRE A BASE OF HYDROLOGIC DATA FOR USE BY AGENCIES ENGAGED IN WATER-RESOURCES PLANNING ON A NATIONAL OR REGIONAL SCALE. AMONG THE CHARACTERISTICS ANALYZED WERE PHYTOPLANKTON IDENTIFICATION AND CELL COUNTS. SAMPLES CONSISTED OF COMPOSITES OF EQUAL ALIQUOTS, COLLECTED AT THE CENTER OF EACH QUARTILE OF FLOW, USING MODIFIED SUSPENDED-SEDIMENT SAMPLERS AND SEDIMENT COLLECTION TECHNIQUES. IDENTIFICATION AND COUNTING WERE DONE USING THE SEDGWICK-RAFTER CELL METHOD. CELL COUNTS RANGED FROM 21 CELLS PER MILLILITRE AT FLATHEAD RIVER AT FLATHEAD, BRITISH COLUMBIA TO 27,000 CELLS PER MILLILITRE AT YELLOWSTONE RIVER NEAR SIDNEY. THE CLASS BACILLARIOPHYCEAE WAS MOST ABUNDANT IN BOTH NUMBER AND VARIETY AT ALL SAMPLING SITES. ANABAENA AND APHANIZOMENON OF THE PHYLLUM CYANOPHYTA WERE FOUND AT SIX STATIONS AND TWO STATIONS RESPECTIVELY. THESE TWO GENERA OF BLUE-GREEN ALGAE OFTEN BECOME ABUNDANT IN ENRICHED WATERS RESULTING IN NUISANCE CONDITIONS. (WOODARD-USGS)

Statistical Analyses of Surface-Water-Quality Variables in the Coal Area of Southeastern Montana
Knapton, J. R.; Ferreira, R. F.
Geological Survey, Helena, MT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-226020, Price codes: A07 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-40, June, 1980. 128 p, 2 Fig, 4 Tab, 17 Ref.,
Journal Announcement: SWRA1407

Since 1974 a network of water-quality stations has been operated in the coal area of southeastern Montana. This report updates a previous report with 2 years of additional data collection and presents statistics and regression equations for water-quality variables. The most apparent feature of the study is the variability of water quality. Time-trend differences are most noticeable, with areal differences being present but more subtle. In comparing stations at the mouths of the five major drainages entering the Yellowstone River from the study area, water from the Powder River ranks near the middle of the group in dissolved-solids concentration (mean the best overall quality with respect to dissolved constituents; extremes are moderated by mixing in the Tongue River Reservoir. Suspended sediment increase in dissolved-solids concentration from the most upstream station to the mouth. Armells and Sarpy Creeks, smallest of the five drainages, have a pool-riffle configuration that influences both dissolved and suspended constituents. Pools permit greater evaporation, thus increasing dissolved-constituent concentrations. They also act as sediment traps. (USGS)

Water Quality of Selected Streams in the Coal Area of Southeastern Montana

Knapton, J. R.; McKinley, P. W.

Geological Survey, Helena, MT. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-273 028, Price codes: A08 in paper copy, A01 in microfiche. Water-Resources Investigations 77-80, September 1977. 145 p, 53 fig, 1 tab, 13 ref.,

Journal Announcement: SWRA1107

This report summarizes and evaluates water-quality data collected at 35 stream sites the the coal region of southeastern Montana. Sarpy Creek, Armells Creek, and Rosebud Creek sometimes have dissolved-solids concentrations that cause water to be marginal for agricultural purposes. At times of rainfall and snowmelt, the runoff water mixes with the base-flow component to improve the overall quality. Water in the Tongue River generally showed a downstream degradation in which some changes were related to lithology of the aquifers contributing water to streamflow. Water from Pumpkin Creek and Mizpah Creek is used mostly for cattle watering. To some extent water is used for irrigation although the salinity hazard was often high. The chemical quality of the Powder River changed little during flow downstream. High sediment loads of the river acted as transporting agents for many of the plant nutrients and trace-element constituents. (Woodard-USGS)

Preliminary digital model of ground-water flow in the Madison Group, Powder River basin and adjacent areas, Wyoming, Montana, South Dakota, North Dakota, and Nebraska

Konikow, L. F., 1976

U.S. Geological Survey Water-Resources Investigations 63-75, 44 p.

Geochemistry of Water in the Fort Union Formation of the Northern Powder River Basin, Southeastern Montana

Lee, R. W.

Geological Survey, Helena, MT. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $8.00 in paper copy, $4.50 in microfiche. Geological Survey Open-File Report 80-336 (WRI), June, 1980. 17 p, 7 Fig, 2 Plates, 2 Tab, 18 Ref., (Released as WSP 2076).

Journal Announcement: SWRA1407

Shallow water in the coal-bearing Fort Union Formation of southeastern Montana was investigated to provide a better understanding of the geochemistry. Springs, wells less than 200 feet deep, and wells greater then 200 feet deep were observed to have different water qualities. Overall, the ground water exists as two systems: a mosaic of shallow, chemically dynamic, and localized recharge-discharge cells superimposed on a deeper, chemically static regional system. Water chemistry is highly variable in the shallow system, whereas sodium and bicarbonate waters characterize the deeper system. Within the shallow system, springs, and wells less than 200 feet deep show predominantly sodium and sulfate enrichment processes from recharge to discharge. These processes are consistent with the observed aquifer mineralogy and aqueous chemistry. However, intermittent mixing with downward moving recharge waters or upward moving deeper waters, and bacterially catalyzed sulfate reduction, may cause apparent reversals in these processes. (USGS)

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Ground-Water-Quality Data From the Northern Powder River Basin, Southeastern Montana

Lee, R. W.

Geological Survey, Helena, MT. Water Resources Div.

Available from OFSS Bx 25425, Fed. Ctr. Denver, CO., paper copy $8.75, microfiche $4.00. Geological Survey open-file report 79-1331 (WRI), October 1979. 55 p, 2 Fig, 1 Plate, 3 Tab, 5 Ref.,

Journal Announcement: SWRA1318

Water-quality data collected during 1973-77 for hydrologic studies in the northern Powder River basin of southeastern Montana provide a data base for shallow ground water. The 665 water samples collected were analyzed for major cations and anions. Of the samples, 516 were from wells and 149 were from springs. About 10 percent of the samples were also analyzed for trace constituents and radiochemistry. The majority of analyses were performed by the Montana Bureau of Mines and Geology laboratory in Butte, Montana. The remaining analyses, including all trace constituent and radiochemical analyses, were performed by the U.S. Geological Survey National Water Quality Laboratory in Denver, Colorado. (Kosco-USGS)

Magnitude and Chemical Quality of Base Flow of Otter Creek, Tongue River, and Rosebud Creek, Southeastern Montana, October 26-November 5, 1977
Lee, R. W.; Slagle, S. E.; Stimson, J. R.
Geological Survey, Helena, MT. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $4.75 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 80-1298 (WRI), February, 1981. 25 p, 1 Fig, 6 Tab, 4 Ref, 1 Plate.,
Journal Announcement: SWRA1415
Hydrologic and chemical data were collected during base-flow conditions on three streams in southeastern Montana from October 26 to November 5, 1977, to characterize groundwater discharge. Maximum measured flow of Otter Creek, an interrupted stream, was 1.2 cubic feet per second. The water chemistry was dominated by sodium, magnesium, and sulfate ions, with a maximum dissolved-solids concentration of 3,540 milligrams per liter. Chemistry of groundwater inflow is dominated by sodium, magnesium, and sulfate. A discharge of 156 cubic feet per second from the Tongue River Reservoir into the Tongue River complicated interpretation of groundwater discharge to the reach downstream from the reservoir. Many reaches of gain and loss were observed along the Tongue River; the flow near the mouth was 233 cubic feet per second. Minor changes in quality of the base flow indicate groundwater discharges dominated by sodium, sulfate, and bicarbonate plus carbonate. Dissolved-solids concentration increased from 506 milligrams per liter near the dam to 630 milligrams per liter near the mouth. Maximum measured flow of Rosebud Creek was 19.0 cubic feet per calcium, and bicarbonate, with dissolved-solids concentrations ranging from 560 to 703 milligrams per liter. Sodium, sulfate, and dissolved solids increase downstream. (USGS)

The coal fields of parts of Dawson, Rosebud, and Custer Counties, Montana in Contributions to economic geologic, 1906--Part II
Leonard, A. G., 1907
U.S. Geological Survey Bulletin 316, p. 194-211.

Potential effects of Surface Coal Mining on the Hydrology of the Greenleaf-Miller area, Ashland coal field, southeastern Montana
Levings, Gary W.,

U.S. Geological Survey Water-Resources Investigations, 84-4101, 31 P.

The Greenleaf-Miller area of the Ashland coal field contains reserves of Federal coal that have been identified for potential lease sale. A hydrologic study was conducted in the potential lease area in 1981 to describe the existing hydrologic system and to assess potential impacts of surface coal mining on local water resources.

The hydrologic data collected from wells, test holes, and springs were used to identify aquifers in the alluvium (Pleistocene and Holocene age) and Tongue River Member of the Fort Union Formation (Paleocene age). Coal, clinker, and sandstone beds comprise the aquifers in the Tongue River Member. The chemical quality of water from these aquifers is characterized by sulfate as the dominant anion, sodium and magnesium as the dominant cations, and extremely small concentrations of chloride.

Most streams are ephemeral and flow only as a result of precipitation. The only perennial surface-water flow in the study area is along short reaches downstream from springs.

A mine plan for the area is not available; thus, the location of mine cuts, direction and rate of mine expansion, and duration of mining are unknown. The mining of the Sawyer and Knobloch coal beds of the Tongue River Member would potentially effect ground-water flow in the area. Declines in the potentiometric surface would be caused by dewatering where the mine pits intersect the water table. Wells and springs would be removed in the mine area. The chemical quality of the ground water may change after moving through the spoils. The change probably would be an increase in the concentration of dissolved solids. Although mining would alter the existing hydrologic systems and remove several springs and shallow wells, alternative ground-water supplies are available that could be developed to replace those lost by mining.

Selected Hydrogeologic Data from the Judith Basin, Central Montana

Levings, J. F.; Dodge, K. A.

Geological Survey, Helena, MT. Water Resources Div.

Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $14.25, Microfiche $4.00. Geological Survey Open-File Report 81-1015, September, 1981. 98 p, 2 Fig, 1 Plate, 5 Tab, 6 Ref.,

Journal Announcement: SWRA1505

Selected hydrogeologic data from the Judith basin, central Montana, have been compiled for use as the physical basis of a ground-water model prepared as part of a 4-year study of Cenozoic and Mesozoic aquifers of the northern Great Plains area of Montana. Records of Cenozoic and Mesozoic aquifers of the northern Great Plains area of Montana. Records of 1,124 wells and 640 springs are tabulated in the report; most of these data have been collected since 1959. Lithologic logs of 68 wells are also included. Chemical data for wells and springs include 290 water samples analyzed for major cation and anion concentrations and 282 water samples analyzed for miscellaneous-constituent concentrations. The locations of wells and springs listed in the report are shown on a map at a scale of 1:250,000. (USGS)

Selective Annotated Bibliography of Geology and Groundwater Resources for the Montana Part of the Northern Great Plains Regional Aquifer-System Analysis

Levings, J. F.; Levings, G. W.; Feltis, R. D.; Hotchkiss, W. R.; Lee, R. W.

Geological Survey, Helena, MT. Water Resources Div.

Availabe from the OFSS, USGS Box 25425, Fed, Ctr., Denver, CO 80225, Price: $13.75 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-401 (WRI), May, 1981. 91 p, 1 Tab.,

Journal Announcement: SWRA1420

Increasing demand for water to meet needs for energy, industry, irrigation, domestic, and municipal uses has resulted in a study of the geology and hydrology of rocks of Mesozoic and Cenozoic age. This report presents the results of a literature search for the part of the study area in Montana. It consists of an annotated listing of pertinent published reports, a partial subject and area index of the reports, and a correlation chart of geologic and aquifer units listed in the annotations. (USGS)

Geology and Water-Yielding Characteristics of Rocks of the Northern Powder River Basin, Southeastern Montana.

Lewis, Barney D., and Roberts, Robert S.

U.S. Geological Survey Miscellaneous Investigations Series, 1978

Suspended Sediment in Selected Streams of Southeastern Montana.

Litke, David W.

U.S. Geological Survey, Water-Resources Investigations 82-4087.

Suspended-sediment data collected from October 1974 through September 1979 at 44 stations in the Powder River structural basin of southeastern Montana were statistically summarized to define sediment relationships between stations and basins and to identify environmental factors that are important in determining sediment yield. Sediment-transport curves were developed for 30 of these stations. Mean-annual suspended-sediment discharges were determined at 15 stations using the flow-duration sediment-transport curve method. Sediment discharges compared within 20 percent at three stations where alternative calculation by daily sampling methods was possible. Mean sediment discharges ranged from 770 to 5,470,000 tons per year. Mean sediment yields ranged from 1.09 to 647 tons per square mile per year and were somewhat less than yields predicted by the Langbein-Schumm precipitation-sediment-yield relation. Low delivery ratios for small drainages indicate that streams may be aggrading. Geographic variations in sediment yield are attributed to precipitation and geology.

Use of Geophysical Logs to Estimate Water-Quality Trends in Carbonate Aquifers

MacCary, L. M.

Geological Survey, Denver, CO. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-224124, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-57, 1980. 23 p, 8 Fig, 2 Tab, 18 Ref.,

Journal Announcement: SWRA1407

The water quality in carbonate aquifers can be determined by analysis of resistivity and porosity logs. When supporting data from water analyses are available, the value of the cementation exponent m can be determined more precisely. Data for this study were taken from logs of oil-test wells, Amstrat sample studies, drill-stem tests and water test wells in parts of Montana, North and South Dakota, and Wyoming. The preferred resistivity curves for apparent water resistivity (Rwa) analyses are the deeply focused laterolog and the induction log. The standard electric log can be used if the drilling mud is not saturated with salt. The preferred porosity logs are the sonic, sidewall neutron, compensated neutron, and the density logs. Older, uncalibrated neutron curves can be empirically calibrated in some instances, however, resulting porosities are frequently anomalous when compared to those determined from core or modern logs. When apparent water resistivity is determined for many wells, the data can be plotted and contoured to outline areas of recharge, direction of probable ground-water movement, and location and salinity of brine areas. (USGS)

Hydrology of the Prairie Dog Creek Drainage Basin, Rosebud and Big Horn Counties, Montana

McClymonds, N. E.

Geological Survey, Helena, MT. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-124850, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-37, March 1982. 64 p, 15 Fig, 12 Tab, 18 Ref.,

Journal Announcement: SWRA1603

The Prairie Dog Creek drainage basin in southeastern Montana was investigated during 1978-79 to establish a basic understanding of its surface-water and ground-water resources and the quality of water in an area having coal-mining potential. The principal minable coal is the 40-to 60-foot-thick Wall and lower Wall coal beds near the middle part of the Tongue River Member of the Fort Union Formation (Paleocene age). Prairie Dog Creek, which originates from springs and seeps from coal and sandstone layers, maintained perennial flow in its upstream and middle reaches then lost flow until the channel near its mouth had only standing water or was dry. The dissolved-solids concentration of streamwater during periods of high flow (1 cubic foot per second) ranged from 700 to about 1,000 milligrams per liter and during periods of lesser flow (0.5 cubic foot per second) ranged from about 1,300 to 1,600 milligrams per liter. Relatively clean sandstone aquifers had transmissivities of about 15 feet squared per day and water of the magnesium sulfate or sodium sulfate type, with dissolved-solids concentrations ranging from about 2,200 to 3,000 milligrams per liter; the water was of a sodium sulfate type and ranged from 1,820 to 4,190 milligrams per liter. The Brewster-Arnold coal aquifer had transmissivities similar to the Wall coal but its water was of a different type, sodium bicarbonate; it also contained large concentration of fluoride (more than 10 milligrams per liter) and had a very high sodium-adsorption ratio (more than 60). (USGS)

Potential effects of surface coal mining on the hydrology of the Corral Creek area, Hanging Woman Creek coal field, southeastern Montana, (in review).
McClymonds, N. E.
U.S. Geological Survey Open-File

Potential effects of surface coal mining on the hydrology of the West Otter Creek coal area, southeastern Montana, (in preparation).
McClymonds, N. E.
U.S. Geological Survey Water-Resources Open-File Report

Water Quality of Selected Streams in the Coal Area of East-Central Montana
McKinley, P. W.
Geological Survey, Helena, MT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-298 840, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-142, April 1979. 49 p, 17 fig, 1 tab, 15 ref.,
Journal Announcement: SWRA1224
In October 1975 the U.S. Geological Survey established a network of nine data-collection stations on eight streams in Montana to monitor water quality in potential coal-mining areas. The report summarizes and evaluates the water-quality data that have been collected during the first 2 years (3 years for 1 station) of network operation. Big Dry Creek, Little Dry Creek, Timber Creek, and Nelson Creek are the principal streams

forming the Big Dry Creek basin, which is tributary to the Missouri River. These streams all contain water of the sodium sulfate type. Concentrations were high for elements. Prairie Elk Creek, Sand Creek, and the Redwater River flow directly into the Missouri River. Prairie Elk and Sand Creeks have mainly sodium bicarbonate water, whereas the Redwater River is predominately sodium sulfate water. All three streams contained water of high and trace-element concentrations. Burns Creek is tributary to the Yellowstone River. The water type is generally sodium sulfate during the spring and summer and sodium bicarbonate during the fall and winter. Water (Woodard-USGS)

Water in Carbonate Rocks of the Madison Group in Southeastern Montana--A Preliminary Evaluation

Miller, W. R.

Geological Survey, Billings, Mont. Water Resources Div.

Available from Supt. of Documents, GPO, Washington, D.C. 20402, price $2.90. Water-Supply Paper 2043, 1976. 51 p, 9 fig, 2 plates, 5 tab, 129 ref.,

Journal Announcement: SWRA1013

Yields from wells in carbonate rocks of the Madison Group in southeastern Montana, range from about 50 gpm (gallons per minute) at several places to 1,400 gpm from a flowing well on the north side of the Porcupine dome. Yields estimated or reported from drill-stem tests range from about 1 to 157 gpm. Dissolved solids in water from the study area range from less than southwestern parts of the area, calcium, magnesium, and sulfate ions constitute more than 75 percent of the dissolved constituents, in milliequivalents per liter in the north, sodium, potassium, and chloride ions constitute more than 50 percent of the dissolved constituents; in the Williston basin, sodium, potassium, and chloride ions constitute more than 75 percent of the total. (Woodard-USGS)

Water Resources of the Central Powder River Area of Southeastern Montana

Miller, W. R.

U.S. Geological Survey Bulletin 108.

Water for domestic, stock, and public use is available from the Fox Hills-lower Hell Creek aquifer of Late Cretaceous age. Water for domestic and stock use is available from the upper part of the Hell Creek Formation of Late Cretaceous age and the lower part of the Fort Union Formation of Paleocene age. Water for irrigation can be obtained from alluvium of Holocene and Pleistocene age along the Powder River. The Fox Hills-lower Hell Creek aquifer yields as much as 188 gallons per minute to wells as deep as 999 feet, but most well yields are 20 gallons per minute or less. The upper part of the Hell Creek Formation yields as much as 12 gallons per minute to wells as deep as 465 feet. The lower part of the Fort Union Formation yields a maximum of 25 gallons per minute to wells as deep as 373 feet. The alluvium of the Powder River yields 600 gallons per minute to the only known irrigation well, which is 40 feet deep.

Water from the Fox Hills-lower Hell Creek aquifer generally contains sodium and bicarbonate or sulfate as the major ions; dissolved-solids concentration is as much as 1,700 milligrams per liter. Sodium, bicarbonate, and sulfate were the major ions in two samples from the upper part of the Hell Creek Formation; the dissolved-solids concentration was 840 milligrams per liter in each sample. Water from the Fort Union Formation contains principally sodium, sulfate, and bicarbonate ions; the dissolved solids concentration ranges from 780 to 2300 milligrams per liter. One water sample from the alluvium contained principally sodium and sulfate ions and had a dissolved-solids concentration of 2,300 milligrams per liter.

The Powder River is the only perennial stream in the study area. The average annual discharge of the Powder River near Locate for the period of record, 1938-69, was 601 cubic feet per second. Instantaneous discharge ranged from 0 to 31,000 cubic feet per second. Dissolved-solids concentration of water from the Powder River for the period of record, 1949-63, ranged from 278 to 5,430 milligrams per liter. Calcium, sodium, and sulfate were the major ions.

Water Resources of the Southern Powder River Area, Southeastern Montana

Miller, W. R.

Montana Bureau of Mines and Geology, Memoir 47, 1981.

Annual Peak Discharges from Small Drainage Areas in Montana for Stations Discontinued Before 1978

Omang, R. J.; Hull, J. A.; Parrett, C.

Geological Survey, Helena, MT. Water Resources Div.

Geological Survey open-file report 79-510, May 1979. 117 p, 2 fig.,

Journal Announcement: SWRA1217

Annual peak stage and discharge data have been tabulated for crest-stage gage sites in Montana. The crest-stage program was begun in July 1955 to investigate the magnitude and frequency of floods from samll drainage areas. The program has expanded from 45 crest-stage gaging stations initially to 172 stations maintained in 1978. From 1955 to 1978, 156 stations have been discontinued. This report is a tabulation of the stage and discharge data for the discontinued stations. (Woodard-USGS)

Annual Peak Discharges from Small Drainage Areas in Montana Through September 1981

Omang, R. J.; Parrett, C.; Hull, J. A.

Geological Survey, Helena, MT. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $15.75 in paper copy, $4.50 in microfiche. Open-File Report 82-270, March 1982. 112 p, 2 Fig, 4 Ref.,

Journal Announcement: SWRA1601

Annual peak stage and discharge data have been collected and tabulated for crest-stage gaging sites in Montana. The crest-stage program was begun in July 1955 to investigate the magnitude and frequency of floods from small drainage areas. The program has expanded from 45 crest-stage gaging stations initially to 172 stations maintained in 1981. Data in the report are tabulated for the period of record. (USGS)

OCCURENCE OF GROUND WATER IN THE JUDITH RIVER FORMATION, NORTH-CENTRAL MONTANA

OSTERKAMP, W. R.

GEOLOGICAL SURVEY, WASHINGTON, D. C.

GEOL SURV HYDROL INVEST ATLAS HA-308, 1 SHEET, 1968. TEXT, 2 MAP, 2 TAB, 7 REF.,

Journal Announcement: SWRA0209

A 1-SHEET HYDROLOGIC ATLAS DESCRIBES THE OCCURRENCE OF GROUNDWATER IN THE CRETACEOUS JUDITH RIVER FORMATION, NORTH-CENTRAL MONTANA. A GEOHYDROLOGIC MAP SHOWS GEOLOGY, GEOLOGIC STRUCTURE CONTOURS, LOCATIONS OF LISTED WELLS, POTENTIOMETRIC SURFACE CONTOURS, AND AREAS OF FLOWING WELLS. CHEMICAL ANALYSES OF 4 REPRESENTATIVE WELLS ARE LISTED. A LIST OF 114 WELLS INVENTORIED FOR THE STUDY INCLUDES LOCATION, OWNER, ALTITUDE, WELL DEPTH, STATIC WATER LEVEL, SHUT-IN PRESSURE OF FLOWING WELLS, ALTITUDE OF POTENTIOMETRIC SURFACE, ALTITUDE OF THE TOP OF THE JUDITH RIVER FORMATION, WATER TEMPERATURE, SPECIFIC CONDUCTIVITY, AND USE. GEOLOGIC CROSS SECTIONS SHOW STRATIGRAPHIC AND POTENTIOMETRIC RELATIONS. A GEOLOGIC COLUMN SHOWS CRETACEOUS MONTANA GROUP STRATIGRAPHY, LITHOLOGY, TOPOGRAPHY AND GEOLOGIC SETTING, AND HYDROLOGY. THE JUDITH RIVER FORMATION IS CONFINED ABOVE AND BELOW BY SHALES. IT YIELDS 1 GPM PER 10 FT OF DRAWFOWN TO WELLS; PROBABLY THE HIGHEST YIELD TO BE EXPECTED IN A 6-INCH WELL IS LESS THAN 200 GPM. FEW WELLS FLOW OVER 10 GPM. SODIUM, SULFATE, BICARBONATE, AND TOTAL DISSOLVED SOLIDS CONCENTRATIONS ARE HIGH. (KNAPP-USGS)

The Richey-Lambert coal field, Richland and Dawson Counties, Montana

Parker, F. S., 1936

U.S. Geological Survey Bulletin 847-C, p. 121-174.

This report describes the coal resources of a 900 square mile area. It includes a description of the geologic structure and stratigraphy and a township-by-township description of the occurrence of coal. Two hundred seventy-six coal sections were measured, and generalized geologic sections show the relative position of the coal beds with respect to one another. The geologic map at a scale of 1:62,500 shows outcrops of coal beds, burned areas, and sites of measured coal sections.

The Mizpah coal field, Custer County, Montana
Parker, F. S., and Andrews, D. A., 1939
U.S. Geological Survey Bulletin 906-C, p. 85-133.

This report contains a geologic map and three geologic sections at a scale of about 1:62,500 of the Fort Union and Hell Creek Formations, whose boundaries have since been revised. Shown on the map are the outcrop and burned area for 24 coal beds. Also included are analyses of seven coal samples and a correlation chart for the coal beds with those in adjacent fields. The text discusses the stratigraphy of the map units and characteristics of the coal beds. A township-by-township description of coal resources is accompanied by more than 1,300 graphic coal sections.

The Rosebud coal field, Rosebud and Custer Counties, Montana
Pierce, W. G., 1936
U.S. Geological Survey Bulletin 847-B, p. 43-120

This report describes the coal resources for a 1,050 square mile area. It includes a description of the stratigraphy including 10 measured sections in the Tullock, Lebo Shale, and Tongue River Members of the Fort Union Formation. The township-by-township description of the occurrence of coal includes 700 measured coal sections and the physical and chemical properties of 5 coal samples. The geologic map at a scale of 1:62,500 shows the outcrops of coal beds, burned areas, and sites of measured coal sections. Two generalized sections show the relative position of the coal beds with respect to one another.

Proposed 20-year plan of mining and reclamation, Westmoreland Resources Tract III, Crow Indian coded area, Montana
U.S. Geological Survey, Reston, VA, USA 396 p., 1976.

Geology and ground-water resources of central and southern Rosebud County, Montana, with chemical analyses of the waters by H. G. Riffenburg
Renick, B. C., 1929
U.S. Geological Survey Water Supply Paper 600, 140 p.

In the northwest corner of the area covered by this report the Claggett, Judith River, and Bearpaw formations of the Montana group (Upper Cretaceous), named in ascending order, crop out. These formations are about 450,300, and 950 feet thick, respectively. The Bearpaw shale is overlain without observable stratigraphic hiatus by the fresh-water Lance formation (Terriary?) age, which has a total thickness of about 925 feet. In the upper part of the Lance formation there are thin unworkable coal beds. Overlying the Lance is the Fort Union formation (Tertiary), which consists of the dark-colored Lebo shale member at the base (100 to 300 feet thick) and a younger light-colored member known as the Tongue River member (1,680 feet thick), made up of alternating beds of sandstone, shale, and coal. Many of these beds of coal are workable. In most of central and southern Rosebud County either the Lance formation or the Fort Union lies at the surface. Terrace gravel of Tertiary and Pleistocene age is present on many of the higher hills. Adjacent to the streams, especially the larger ones, there are belts of alluvium consisting of gravel, sand, and clay which are derived from the consolidated rocks and from the terrace gravel.

The most pronounced structural feature in this region is the Porcupine Dome, the southern nose of which is exposed in the northwest corner of the area shown on the map. There are minor folds on the flanks of the dome. South of the Porcupine dome is a southeastern prolongation of the Bull Mountain syncline. Along the flanks of the syncline and in the vicinity of Hopsonville there are faults of slight displacement. It is probable that the faulting was coincident with the deformation that resulted in the uplift of the Porcupine dome.

The chief water-bearing formations in this area are the sandstone and coal beds of the Lance formation and the sandstone, coal, and clinker beds of the Fort Union formation. A supply of water can generally be had where the Lance and Fort Union formations are thick enough to extend below the water table. In the Lance and Fort Union formations and probably also in the underlying Cretaceous formations water from shallow depths (that is, less than perhaps 125 feet) contains considerable calcium and magnesium and is therefore hard, but the water from greater depths contains only small amounts of calcium and magnesium and is therefore soft. This natural softening with increase in depth is due to the fact that as the water gradually percolates downward and moves laterally, the silicate minerals in the rocks exchange their sodium for the calcium and magnesium in the water. The soft water from the Lance and Fort Union formations, which is a sodium bicarbonate water, is generally satisfactory for domestic purposes, although in many places not entirely satisfactory for cooking; but it foams when used in boilers and is unfit for irrigation, as it produces a hard crust of black alkali on the surface of the land. The hard water from shallow depths in the areas of Lance and Fort Union domestic purposes, but it contains a considerable amount of scale-forming constituents.

The Colorado, Claggett, Judith River, and Bearpaw formations consist chiefly of highly mineralized shales that yield either no water or only very meager supplies of poor water. The Judith River formation contains some beds of water-bearing sandstone. Where these sandstones are not covered by the mineralized shale of the Judith River or Bearpaw formations they yield water of good quality, which is satisfactory for domestic use, for stock, and for irrigation. Such water generally contains less dissolved mineral matter than the water in the Lance and Fort Union formations. The Kootenai (?) formation contains water-bearing sandstones, but, so far as known, the water in these sandstones is highly mineralized and generally unsatisfactory for all uses.

In much of the area where the Pleistocene and older terrace gravel is present it is of sufficient thickness to extend below the water table and will yield considerable supplies of water. This water contains less dissolved mineral matter than the water from any other formation in the region and is satisfactory for domestic use, stock, and irrigation but is somewhat hard and contains an appreciable amount of scale-forming ingredients.

The alluvium along the Yellowstone River, the Tongue River, and the other streams in the region of Lance and Fort Union rocks yields hard water to shallow dug or bored wells. Such water is generally satisfactory for stock, for drinking, and for irrigation but is rather hard for domestic use and is generally unsatisfactory for industrial uses because of the relatively large amount of scale-forming constituents that it contains.

Flowing artesian wells along the flood plain of the Yellowstone River in the eastern part of the area derive their water from the Lance formation; those along the flood plain of the Tongue River in the vicinity of Ashland and Birney derive their water from the Fort Union formation. The water from all the artesian wells in both areas is soft. It is probable that flowing wells may be obtained by drilling into the Tongue River member at some places along the flood plain of the Tongue River between Ashland and Birney, but it is not feasible to predict exactly where such flows may be obtained.

Many of the flowing wells along the Yellowstone and Tongue Rivers yield some hydrocarbon gas, mostly methane derived from the coal and carbonaceous material in the Lance and Fort Union formations. In places there is evidence that the methane reduces the sulphate in the ground water, with the resulting formation of hydrogen sulphide and carbonate or bicarbonate.

Hydrogeologic Data for Selected Coal Areas, East-Central Montana

Roberts, R. S.

Geological Survey, Helena, MT. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $10.50 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 80-329 (WRI), April, 1980. 63 p, 2 Fig, 4 Tab, 1 Plate.,

Journal Announcement: SWRA1415

Hydrogeologic data were collected in selected coal areas of east-central Montana to provide a basis for evaluating the effects of future coal development on the groundwater resources. Inventory records for 916 domestic, stock, public supply, commercial, and test wells are tabulated in the report; the data were collected principally from 1975 through 1976. The locations of the wells are shown on a map at a scale of 1:250,000. Lithologic logs are also included for 149 wells. Chemical analyses of water samples from selected wells consist of 167 samples analyzed for major cations and anions and 24 samples analyzed for miscellaneous constituents. (USGS)

Ground-water resources and potential effects of coal strip mining in the northern Powder River basin, southeastern Montana
Slagle, S. E., Lewis, B. D., and Lee, R. W.
U.S. Geological Survey Water-Supply Paper

Hydrology of Area 49, Northern Great Plains and Rocky Mountain coal provinces, Montana and Wyoming
Slagle, S. E., and others
U.S. Geological Survey Water-Resources Investigations Open-File Report.

Geology of the Pust lignite bed in the Burns Creek-Thirteen mile Creek Known Coal Leasing Area, Dawson and Richland Counties, Montana
Spencer, J. M., 1976
U.S. Geological Survey Open-File Report 76-617, 6 p.

Coal geology of the Girard area, Richland and Roosevelt Counties, Montana
Spencer, M. A. S., 1980
U.S. Geological Survey Open-File Report 80-213, 11 p.

The Sidney lignite field, Dawson County, Montana in Contributions to economic geology, 1910-Part II
Stebinger, Eugene, 1912
U.S. Geological Survey Bulletin 471, p. 284-318.

Hydrogeology of the Fort Union coal region, eastern Montana
Stoner, J. D., and Lewis, B. D., 1980
U.S. Geological Survey Miscellaneous Investigations Map I-1236, 2 sheets.

This report consists of a hydrogeologic map at a scale of 1:500,000 showing the configuration of the top of the Bearpaw confining layer, a regional-scale map showing the structural features of eastern Montana, three geologic sections, a table describing the stratigraphy and water-yielding characteristics of the map units from the Bearpaw confining layer through the alluvial aquifer, and representative electric logs correlating geologic and hydrogeologic units.

Geology and ground-water resources of the Missouri River valley in northeastern Montana, with a section on the quality of the ground water by W. H. Duram
Swenson, F. A., 1955
U.S. Geological Survey Water-Supply Paper 1263, 128 p.

POSSIBLE DEVELOPMENT OF WATER FROM MADISON GROUP AND ASSOCIATED ROCK IN POWDER RIVER BASIN, MONTANA-WYOMING
SWENSON, F. A.
GEOLOGICAL SURVEY, DENVER, COLO.
REPORT FOR THE NORTHERN GREAT PLAINS RESOURCES PROGRAM, JULY 1, 1974. 6 P, 4 PLATE.,
Journal Announcement: SWRA0808
THE POTENTIAL FOR DEVELOPING LARGE GROUNDWATER SUPPLIES FOR INDUSTRIAL USE IN THE POWDER RIVER BASIN OF WYOMING AND MONTANA IS SUMMARIZED. RECORDS OF MANY OIL TESTS AND SEVERAL WATER WELLS INDICATE THAT THE MADISON GROUP AND THE UNDERLYING CARBONATE ROCKS ARE HYDROLOGICALLY CONNECTED AND TRANSMIT WATER AS A UNIT. ALSO, IN MANY LOCALITIES, THE OVERLYING TENSLEEP AND MINNELUSA SANDSTONES ARE ALSO CONNECTED WITH THE MADISON. THESE ROCKS UNDERLIE THE ENTIRE BASIN AND ARE EXPOSED ON THE FLANKS OF THE SURROUNDING MOUNTAINS. THE MADISON ROCKS, AND TO A CONSIDERABLE EXTENT THE UNDERLYING CARBONATES, ARE FRACTURED AND CAVERNOUS. LARGE QUANTITIES OF WATER HAVE BEEN DERIVED FROM THESE ROCKS IN THE MIDWEST, WYOMING AREA SINCE 1917. THE MADISON AND UNDERLYING CARBONATES CONTAIN WATER OF MODERATE-TO-GOOD QUALITY THAT IS PROBABLY SUITABLE FOR INDUSTRIAL USE. IT CONTAINS TOO HIGH A PERCENTAGE OF SODIUM FOR IRRIGATION USE. (KNAPP-USGS)

POTENTIAL OF MADISON GROUP AND ASSOCIATED ROCKS TO SUPPLY INDUSTRIAL WATER NEEDS, POWDER RIVER BASIN, WYOMING AND MONTANA. (Duplicated see Wyoming)
SWENSON, F. A.
GEOLOGICAL SURVEY, DENVER, COLO.
IN: WATER RESOURCES PROBLEMS RELATED TO MINING: AMERICAN WATER RESOURCES ASSOCIATION PROCEEDINGS SERIES NO 18, P 210-218, JUNE 1974. 5 FIG, 4 REF.,
Journal Announcement: SWRA0902

GROUND WATER RESOURCES OF THE NORTHERN POWDER RIVER VALLEY, SOUTHEASTERN MONTANA
TAYLOR, JAMES O.
U. S. GEOLOGICAL SURVEY.
MONT. BUR. OF MINES AND GEOL. BULL. 66, 34 P, MAY 1968. 17 FIG, 1 PLATE, 9 TAB, 32 REF, 1 APPEND.,
Journal Announcement: SWRA6803
THE DOMESTIC, STOCK, INDUSTRIAL, AND MUNICIPAL WATER SUPPLIES OF THE NORTHERN POWDER RIVER VALLEY DEPEND ON GROUNDWATER FROM THE AQUIFERS IN THE LATE CRETACEOUS FOX HILLS

SANDSTONE AND HELL CREEK FORMATION, THE PALEOCENE FORT UNION FORMATION, AND PLEISTOCENE TO RECENT TERRACE DEPOSITS. THE MOST CONTINUOUS AND DEPENDABLE AQUIFER IS THE FIX HILLSBASAL HELL CREEK ARTESIAN AQUIFER WHICH AVERAGES 250 FT IN THICKNESS, HAS A MEAN TRANSMISSIBILITY OF ABOUT 820 GPD PER FT, AND A STORAGE COEFFICIENT OF ABOUT .00026. THE RECHARGE AREA IS IN THE SOUTHEASTERN MONTANA, AND WATER MOVES NORTHWEST TO DISCHARGE INTO THE YELLOWSTONE RIVER VALLEY BY LEAKAGE THROUGH OVERLYING CONFINING BEDS. THE ARTESIAN AQUIFERS IN THE FORT UNION FORMATION ARE DISCONTINUOUS AND ARE RECHARGED AT VARIOUS PLACES, BUT THE DIRECTION OF MOVEMENT IS ALSO NORTHWARD TO DISCHARGE THROUGH SPRINGS. DISSOLVED-SOLIDS CONTENT IN THE GROUNDWATER IS LESS THAN 1,000 PPM. WATER IN THE FOX HILLS AND HELL CREEK FORMATION IS SOFT; WATER FROM THE HIGHER FORMATIONS IS HARD. DISSOLVED GAS, MOSTLY NITROGEN, IS FOUND IN THE FOX HILLS-BASAL HELL CREEK AQUIFER. IN GENERAL THE WATER IS SATISFACTORY FOR DOMESTIC AND STOCK USE BUT UNSATISFACTORY FOR IRRIGATION. SUPPLIES ARE ADEQUATE FOR PRESENT AND PROJECTED FUTURE USE. (KNAPP-USGS)

Geology of Big Horn County and the Crow Indian Reservation with special reference to the water, coal, oil, and gas resources
Thom, W. T., Jr., Hall, G. M., Wegemann, C. H., and Moulton, G. F., 1935
U.S. Geological Survey Bulletin 856, 200 p.

Geology and ground-water resources of the lower Yellowstone River valley, between Glendive and Sidney, Montana, with a section on Chemical quality of the water by H. A. Swenson
Torrey, A. E., and Kahout, F. A., 1956
U.S. Geological Survey Water-Supply Paper 1355, 92 p.
This report contains a geologic map at a scale of about 1:27,000 and a table describing the stratigraphy and the water-bearing characteristics of the Fox Hills Sandstone, the Hell Creek and Fort Union Formations, and the Quaternary deposits. Except for a short discussion of geology, the text primarily describes the hydrology and chemical quality of ground and surface waters.

Ground-water resources of the lower Yellowstone River valley between Miles City and Glendive, Montana, with a section on The chemical quality of the water by H. A. Swenson
Torrey, A. E., and Swenson, F. A., 1951
U.S. Geological Survey Circular 93, 72 p.
This report describes the geology and hydrology of exposed bedrock and alluvial deposits in the Yellowstone River valley. The text contains a description and a generalized section of the lithology and water-bearing properties of the Pierre Shale through the Fort Union Formation and alluvial deposits. Included

is a geologic map of the Yellowstone River valley at a scale of 1:63,360.

PROSPECTS FOR DEVELOPING STOCK-WATER SUPPLIES FROM WELLS IN NORTHEASTERN GARFIELD COUNTY, MONTANA
VAN LEWEN, M. C.; KING, N. J.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
AVAILABLE FROM SUP DOC, GPO, WASH, D.C. 20402 - PRICE 75 CENTS. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1999-F, 1971. 38 P, 6 FIG, 1 PLATE, 7 TAB, 14 REF.,
Journal Announcement: SWRA0424
A PRACTICAL AND RELIABLE SOURCE OF LIVESTOCK WATER EXISTS ON BOTH PUBLIC AND PRIVATELY OWNED GRAZING LAND IN NORTHEASTERN GARFIELD COUNTY, MONTANA. THIS COMPRISES AN AREA OF SOME 1,200 SQUARE MILES. THE PRINCIPAL BEDROCK AQUIFER IS THE FOX HILLS SANDSTONE FORMATION OF UPPER CRETACEOUS AGE. IT IS EXPOSED ON THE SURFACE IN THE NORTHERN AND NORTHWESTERN PART OF THE COUNTY PENETRATING THIS AQUIFER REACH WATER AT ABOUT 200 FEET. AMPLE WATER IS AVAILABLE FOR LIVESTOCK USE FROM WELLS DRILLED IN THIS AQUIFER. MOST OF THESE WELLS REACH THE AQUIFER AT 195 FEET. UNDERFLOW IN ALLUVIAL DEPOSITS ALONG THE LARGER STREAM VALLEYS IS ANOTHER SOURCE OF LIVESTOCK WATER. CHEMICAL ANALYSIS OF SAMPLES COLLECTED AT 43 WELLS AND 3 SPRINGS SHOW THE WATER QUALITY TO BE GENERALLY POOR. WATER FROM THE FOX HILLS AQUIFER AND OTHERS ASSOCIATED WITH IT CONTAINS 530-5, 340 MILLIGRAMS PER LITER OF TOTAL MILLIGRAMS PER LITER OF TOTAL DISSOLVED SOLIDS. THE PRINCIPAL CONSTITUENTS ARE SODIUM, BICARBONATE, AND SULFATE. ALL WATER SUPPLIES TESTED WERE SUITABLE FOR LIVESTOCK USE. (GLASBY-USGS)

Bibliography of Geology and Ground-water Resources for the Montana Part of the Northern Great Plains Regional Aquifer-System Analysis.

Stripping coal deposits of the northern Great Plains, Montana, Wyoming, North Dakota, and South Dakota
U.S. Geological Survey, 1974
U.S. Geological Survey Miscellaneous Field Studies Map MF-590, 1 sheet.

Plan of study of the hydrology of the Madison Limestone and associated rocks in parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming
U.S. Geological Survey, 1975
U.S. Geological Survey Open-File Report 75-631, 35 p.
This report summarizes the present (1975) knowledge of the geohydrology of the Madison and associated rocks, identifies the need for additional data, and outlines a 5-year plan for a comprehensive study of the hydrology of these rocks.

Preliminary report of coal drill-hole data and chemical analyses of coal beds in Campbell and Sheridan Counties, Wyoming; Custer, Prairie, and Garfield Counties, Montana; and Mercer County, North Dakota
U.S. Geological Survey and Montana Bureau of Mines and Geology, 1976a
U.S. Geological Survey Open-File Report 76-319, 377 p.

Preliminary report of coal drill-hole data and chemical analyses of coal beds in Campbell, Converse, and Sheridan Counties, Wyoming; and Big Horn, Richland, and Dawson Counties, Montana
U.S. Geological Survey and Montana Bureau of Mines and Geology, 1976b
U.S. Geological Survey Open-File Report 76-450, 382 p.

Preliminary report on 1976 drilling of coals in Campbell and Sheridan Counties, Wyoming; and Big Horn, Dawson, McCone, Richland, Roosevelt, Rosebud, Sheridan, and Wibaux Counties, Montana
U.S. Geological Survey and Montana Bureau of Mines and Geology, 1977
U.S. Geological Survey Open-File Report 77-283, 403 p.

Geophysical logs for Powder River and Dawson Counties, Montana, Chapter C of Preliminary report of 1977 coal drilling in eastern Montana and northeastern Wyoming
U.S. Geological Survey and Montana Bureau of Mines and Geology, 1978a
U.S. Geological Survey Open-File Report 77-721-C, 79 p.

Geophysical logs for Dawson, Garfield, McCone, and Prairie Counties, Montana, chapter D of Preliminary report of 1977 coal drilling in eastern Montana and northeastern Wyoming
U.S. Geological Survey and Montana Bureau of Mines and Geology, 1978b
U.S. Geological Survey Open-File Report 77-721-D, 101 p.

Geophysical logs for Dawson, McCone, Richland, and Rosebud Counties, Montana, chapter F of Preliminary report of 1977 coal drilling in eastern Montana and northeastern Wyoming
U.S. Geological Survey and Montana Bureau of Mines and Geology, 1978c
U.S. Geological Survey Open-File Report 77-721-F, 73 p.

Shallow ground water in selected areas in the Fort Union Coal region
U.S. Geological Survey, 1974
U.S. Geological Survey Open-File Report 74-371, 130 p.

Ground Water of the Fort Union Coal Region, Eastern Montana
Geological Survey, Helena, MT. Water Resources Div.
Montana Bureau of Mines and Geology Special Publications 80, 1978. 47 p.,
Journal Announcement: SWRA1209

The hydrologic findings of numerous studies recently completed or currently underway by the Montana Bureau of Mines and Geology and the U.S. Geological Survey are described. Pertinent facts are given on the occurrence, movement, and quality of ground water in the Fort Union Coal Region of Montana. The present development, effects of seismic shotholes on ground-water systems, and effects of strip mining of coal on shallow ground-water systems are described also. The primary purpose of the report is to provide basic factual material on ground-water conditions to assist nontechnical readers in understanding the complex ground-water problems existing in eastern Montana. (Woodard-USGS)

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1970: PART 6. MISSOURI RIVER BASIN
GEOLOGICAL SURVEY, RESTON, VA.
AVAILABLE FROM SUPT. OF DOCUMENTS, GPO, WASHINGTON, D.C. 20402, PRICE $4.70. WATER-SUPPLY PAPER 2155, 1975. 554 P, 1 FIG, 41 REF.,
Journal Announcement: SWRA0824

DURING THE WATER YEAR ENDING SEPTEMBER 30, 1970, THE GEOLOGICAL SURVEY MAINTAINED 258 STATIONS ON 123 STREAMS IN THE MISSOURI RIVER BASIN FOR THE STUDY OF CHEMICAL AND PHYSICAL CHARACTERISTICS OF SURFACE WATER. SAMPLES WERE COLLECTED DAILY AND MONTHLY AT 226 OF THESE LOCATIONS FOR CHEMICAL-QUALITY STUDIES. SAMPLES ALSO WERE COLLECTED LESS FREQUENTLY AT MANY OTHER POINTS. WATER TEMPERATURES WERE MEASURED CONTINUOUSLY AT 35 AND DAILY AT 67 STATIONS. DAILY WATER TEMPERATURES WERE MEASURED AT MOST OF THE STATIONS AT THE TIME SAMPLES WERE COLLECTED FOR CHEMICAL OR SEDIMENT CONTENT. SO FAR AS PRACTICABLE, THE WATER TEMPERATURES WERE TAKEN AT ABOUT THE SAME TIME ACH DAY. QUANTITIES OF SUSPENDED SEDIMENT ARE REPORTED FOR 38 STATIONS DURING THE YEAR ENDING SEPTEMBER 30, 1970. SEDIMENT SAMPLES WERE COLLECTED ONE OR MORE TIMES DAILY AT MOST STATIONS, DEPENDING ON THE RATE OF FLOW AND CHANGES IN STAGE OF THE STREAM. PARTICLE-SIZE DISTRIBUTIONS OF SEDIMENTS WERE DETERMINED AT 41 STATIONS. THE STREAM DISCHARGE REPORTED FOR A COMPOSITE SAMPLE IS USUALLY THE AVERAGE OF DAILY MEAN DISCHARGES FOR THE COMPOSITE PERIOD. THE DISCHARGES REPORTED IN THE TABLES OF SINGLE ANALYSES ARE EITHER DAILY MEAN DISCHARGES OR DISCHARGES OBTAINED AT THE TIME SAMPLES WERE COLLECTED AND COMPUTED FROM A STAGE-DISCHARGE RELATION OR FROM A

DISCHARGE MEASUREMENT. (WOODARD-USGS)

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1969: PART 6. MISSOURI RIVER BASIN

GEOLOGICAL SURVEY, RESTON, VA.

WATER-SUPPLY PAPER 2145, 1974. 441 P, 1 FIG, 40 REF.,

Journal Announcement: SWRA0823

DURING THE WATER YEAR ENDING SEPTEMBER 30, 1969, THE GEOLOGICAL SURVEY MAINTAINED 212 STATIONS ON 110 STREAMS FOR THE STUDY OF CHEMICAL AND PHYSICAL CHARACTERISTICS OF SURFACE WATER IN THE MISSOURI RIVER BASIN. SAMPLES WERE COLLECTED DAILY AND MONTHLY AT 177 OF THESE LOCATIONS FOR CHEMICAL-QUALITY STUDIES. SAMPLES ALSO WERE COLLECTED LESS FREQUENTLY AT MANY OTHER POINTS. WATER TEMPERATURES WERE MEASURED CONTINUOUSLY AT 35 AND DAILY AT 77 STATIONS. DAILY WATER TEMPERATURES WERE MEASURED AT MOST OF THE STATIONS AT THE TIME SAMPLES WERE COLLECTED FOR CHEMICAL QUALITY OR SEDIMENT CONTENT. SO FAR AS PRACTICABLE, THE WATER TEMPERATURES WERE TAKEN AT ABOUT THE SAME TIME EACH DAY. QUANTITIES OF SUSPENDED SEDIMENT ARE REPORTED FOR 40 STATIONS DURING THE YEAR ENDING SEPTEMBER 30, 1969. SEDIMENT SAMPLES WERE COLLECTED ONE OR MORE TIMES DAILY AT MOST STATIONS, DEPENDING ON THE RATE OF FLOW AND CHANGES IN STAGE OF THE STREAM. PARTICLE-SIZE DISTRIBUTIONS OF SEDIMENTS WERE DETERMINED AT 44 STATIONS. THE STREAM DISCHARGE REPORTED FOR A COMPOSITE SAMPLE IS USUALLY THE AVERAGE OF DAILY MEAN DISCHARGES FOR THE COMPOSITE PERIOD. THE DISCHARGES REPORTED IN THE TABLES OF SINGLE ANALYSES ARE EITHER DAILY MEAN DISCHARGES OR DISCHARGES OBTAINED AT THE TIME SAMPLES WERE COLLECTED AND COMPUTED FROM A STAGE-DISCHARGE RELATION OR FROM A DISCHARGE MEASUREMENT. (WOODARD-USGS)

Water Resources Data for Montana, Published annually since 1975.

Geological Survey, Helena, MT. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161.

Water resources data for Montana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. Additional water data were collected at various sites, not part of the systematic data-collection programs, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (USGS)

Water-Resources Investigations of the U.S. Geological Survey

in Montana, published annually since 1975.
Geological Survey, Helena, MT. Water Resources Div.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225,

These reports describe the investigative efforts of the U.S. Geological Survey toward the water resources of Montana. Hydrologic information and knowledge of the water resources are gained and disseminated principally by programs of (1) collecting hydrologic data on a continuing basis, (2) conducting water-resources appraisals of surface and ground water, (3) conducting supportive research in hydrology and related fields, (4) disseminating water data and results of investigations to the public, (5) coordinating acquisition of water data by Federal agencies, and (6) providing technical assistance in hydrologic fields to other government agencies. (USGS)

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WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN THE NORTHERN GREAT PLAINS COAL REGION OF EASTERN MONTANA, 1975-76
GEOLOGICAL SURVEY, HELENA, MONT.
OPEN-FILE REPORT, JANUARY 1976. 29 P, 10 FIG.,
Journal Announcement: SWRA0912

THIS REPORT PRESENTS THE WATER DATA-COLLECTION PROGRAM AND INTERPRETIVE HYDROLOGIC INVESTIGATIONS THAT ARE BEING CONDUCTED BY THE U.S. GEOLOGICAL SURVEY IN THE NORTHERN GREAT PLAINS REGION OF EASTERN MONTANA. THE AREA IS OF INTENSE INTEREST FOR COAL COMPANIES, UTILITIES, STATE AND FEDERAL AGENCIES, UNIVERSITIES, PRIVATE CITIZENS, LANDOWNERS, AND ENVIRONMENTAL GROUPS. IN OCTOBER 1975 THERE WERE 45 STREAMFLOW AND 64 WATER-QUALITY DATA-COLLECTION STATIONS IN THE REGION FOR COLLECTION OF STREAMFLOW, CHEMICAL-QUALITY, SEDIMENT, AND TEMPERATURE DATA. THESE STATIONS ARE LOCATED ON ALL TYPES OF STREAMS FROM THE MAINSTEM YELLOWSTONE AND MISSOURI RIVERS TO SMALL EPHEMERAL AND INTERMITTENT STREAMS THAT DRAIN PROPOSED MINE AREAS. GROUNDWATER INVESTIGATIONS ARE BEING CONDUCTED TO DETERMINE THE AREAL HYDROLOGY OF THE MADISON GROUP AND ASSOCIATED PALEOZOIC ROCKS AND THE AREAL AND SITE HYDROLOGY OF SHALLOW AQUIFERS IN THE FORT UNION FORMATION, INCLUDING THE COAL BEDS. AVAILABLE DATA, MOSTLY FROM OIL TESTS, INDICATE THAT THE MADISON MAY YIELD WATER SUITABLE FOR USE IN ENERGY DEVELOPMENT IN THE NORTHERN GREAT PLAINS COAL REGION. FIELDWORK IN THE SHALLOW GROUNDWATER STUDY CONSISTS PRINCIPALLY OF AN INVENTORY OF WELLS AND SPRINGS AND CONSTRUCTION OF WELLS FOR WATER SAMPLING, AQUIFER TESTING, AND WATER-LEVEL MEASUREMENTS. A COMPUTER MODEL IS BEING CONSTRUCTED TO DETERMINE THE EFFECT ON STREAM TEMPERATURE OF SELECTED INCREASES IN WITHDRAWAL RATES, AND THUS REDUCED FLOW, OF THE YELLOWSTONE RIVER FROM BILLINGS TO SIDNEY, MONT. (WOODARD-USGS)

Preliminary study of the coal deposits in the Circle area, McCone, Dawson, and Garfield Counties, Montana
Wincentsen, Herbert, 1978
U.S. Geological Survey Open-File Report 78-367, 11 p.

Coal geology of the Northeast Circle area, McCone and Dawson Counties, Montana
Wincentsen, Herbert, 1979
U.S. Geological Survey Open-File Report 79-1052, 11 p.

Documentation of a dissolved-solids model of the Tongue River, Southeastern Montana
Woods, P. F., 1981a
U.S. Geological Survey Open-File Report 81-479, 41 p.

A model has been developed for assessing potential increases in dissolved solids of streams as a result of leaching of overburden materials used to backfill pits in surface coal-mining operations. The model allows spatial and temporal simulation of streamflow and dissolved-solids loads and concentrations under user-defined scenarios of surface coal mining and agricultural development. The model specifically addresses the Tongue River from the Tongue River Dam to Miles City, Montana, and its three major tributaries, Hanging woman, Otter, and Pumpkin Creeks.

The model routes an input quantity of streamflow and dissolved solids from the upstream end to the downstream end of a stream reach while algebraically accounting for gains and losses of streamflow and dissolved solids within the stream reach. Input data needed to operate the model include the following: simulation number, designation of hydrologic conditions for each simulated month, either user-defined or regression-defined concentrations of dissolved solids input by the Tongue River Reservoir, number of irrigated acres, number of mined acres, dissolved-solids concentration of mine leachates, and quantity of other water losses.

The computer program is written in FORTRAN language. A listing of the computer program, definitions of all variables in the model, and an example output will permit use of the model by interested persons.

Modeled impacts of surface coal mining on dissolved solids in the Tongue River, southeastern Montana
Woods, P. F., 1981b
U.S. Geological Survey Water-Resources Investigations 81-64, 73 p.

A computer model has been developed for assessing potential increases in dissolved solids of streams as a result of leaching of overburden materials used to backfill pits in surface coal-mining operations in southeastern Montana. The model allows spatial and temporal simulation of streamflow and dissolved-solids loads and concentrations for user-defined plans of surface coal mining and agricultural development. The model specifically addresses the Tongue River from the Tongue River Dam to Miles City, Montana, and its three major tributaries, Hanging Woman, Otter, and Pumpkin Creeks. Provision is made to simulate releases from the present Tongue River Reservoir or the increased releases expected from a larger dam and reservoir proposed as a replacement for the present Tongue River Reservoir.

The model routes an input quantity of streamflow and dissolved solids from the upstream end to the downstream end of a stream reach while algebraically accounting for gains and losses of streamflow and dissolved solids within the stream reach. Data used to program the computational routines of the model are evaluated in terms of the model's predictive capability.

A hypothetical plan was formulated for the mining of all Federally owned coal judged potentially available for mining. Under this plan, a simulation using mean streamflow from the present Tongue River Reservoir indicates that the mean annual dissolved-solids concentration of 646 milligrams per liter with no mining is increased by mining to 677 milligrams per liter. When the proposed Tongue River Reservoir is used in the simulation, the shift in dissolved-solids concentration is from 436 to 451 milligrams per liter, which is illustrative of the dilutional effect of increased streamflow on concentration. Calculations were performed with data representative of the study area to determine the relative impacts of irrigation and surface coal mining on unit area basis in a hypothetical stream. The dissolved-solids concentration of the hypothetical stream was determined to increase annually by 2.94 percent as a result of withdrawal and return flow of irrigation water and by 0.22 percent as a result of leachates from surface coal mines.

The computer program is written in FORTRAN language. A listing of the computer program, input data requirements, definitions of all variables in the model, and an example output will permit use of the model by interested persons. Input data needed to operate the model include the following: Simulation number, designation of hydrologic conditions for each simulated month, designation of present or proposed Tongue River Reservoir, either user-defined or regression-defined concentrations of dissolved solids input by the Tongue River Reservoir, number of irrigated acres, number of mined acres, dissolved-solids concentration of mine leachates, and quantity of other water losses.

Bear Creek Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in the West Moorehead Coal Field, southeastern Montana
BLM, Denver, Colorado
EMRIA Rept. No. 8-77

The 3,200-acre Bear Creek site is above the northern Powder River Basin where the strata dip southwestwardly less than 3 degrees. Nearly 166 million tons of coal are in the Anderson, Dietz and Canyon coal beds, 90 percent of which are more than 10 feet thick, and are covered by less than 200 feet of overburden. The site is mostly gently sloping valley floors merging laterally into steep, semi-badlands and irregular remnants capped by sandstone. The semiarid (precipitation less than 15 inches per year) site is mostly drained by Bear Creek and partly by Vance Creek, both intermittent. Stream dissolved solids ranged from 140 (at 53 cubic feet per second of snowmelt runoff) to 2,330 milligrams per liter at near-low flow. Solids dissolved in alluvial water (5 gallons per minute from one of the test holes) ranged from 2,720 to 5,040 milligrams per liter. Water also was found under water-table, semi-confined, and confined conditions in discontinuous sandstones and persistent coal layers. Yields are small, less than 3 gallons per minute, and dissolved solids ranged from 1,110 to 4,760 milligrams per liter. The site is a recharge area and large yields should not be expected from these aquifers. Madison Group aquifers 10,000 feet below the site have produced more than 1,000 gallons per minute from a single well nearby. Surface mining would dewater the shallow aquifers, reducing stream flow and affecting 8 stock and one domestic well. Replacement wells and discharge of mine water would mitigate these impacts.

Hanging Woman Creek Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in the Hanging Woman Creek Coal Field, south-central Montana
BLM, Denver, Colorado
EMRIA Report No. 12-77

The 34.3 square-mile Hanging Woman Creek study area is coincident with the elongate drainage basin of East Trail Creek. Relief is as much as 600 feet from the alluvium-entrenched creek, up gentle to moderately steep slopes to sandstone-supported flat ridges. Intermittent East Trail Creek slopes to Trail Creek, also intermittent, a tributary to Hanging Woman Creek. Precipitation ranges from about 12 to 19 inches depending on elevation. Most coal is found in two beds of the Fort Union Formation's Tongue River Member. The Anderson coal bed ranges from 26 to 33 feet thick and the Dietz bed, 50 to 100 feet below, is from 9 to 12 feet thick. More than 433 million tons of coal in these two beds underlie less than 200 feet of overburden. Perched and semi-confined aquifers in and above the coal beds yielded as much as 10 gallons per minute during fractional day pump tests. One test of 30 feet of alluvium produced 18 gallons per minute for more than 9 hours. Dissolved solids in water from wells in bedrock ranged from 438 to 9,460 milligrams per liter and in East Trail Creek alluvium from 1,500 to 4,510 milligrams per liter. Surface mining would drain the shallow aquifers at a diminishing rate beginning at 0.7 cubic feet per second, and dry up 17 stock wells or springs and remove 15 perennial and 4 ephemeral stock ponds. All could be replaced. Water would not be needed for reclamation.

Meridian Coal Exchange, northeastern Montana
BLM, Miles City, Montana
EA, 1982

This document assesses relative impacts of surface mining of coal on two tracts involved in an exchange of coal ownership between the Meridian Land and Mineral Company and the Bureau of Land Management. About 856 million tons of strippable coal underlie the 69.5 square miles of both tracts. The lignite coal is in two beds of the Tongue River Member of the Fort Union Formation, part of the Circle West coal deposit. The tracts are drained by tributaries to through-flowing ephemeral creeks. Annual runoff of 0.4 inch ranges from 300 to 7,700 milligrams per liter dissolved solids. The tracts contain 37 small stock ponds, most of which are dry by fall. Small amounts of water containing between 1,000 and 4,000 milligrams per liter of total dissolved solids occur in the coal layers and in sandstone lenses above the coal. One well obtains water from alluvium where water quality ranges from good to poor. No data is provided for the 19 observation and 18 stock wells in the tracts. Nearby wells tap the Cretaceous Fox Hills Formation 1,200 to 1,500 feet below the surface and yield as much as 200 gallons per minute of sodium bicarbonate water ranging from 500 to 2,000 milligrams per liter of total dissolved solids. Mining would remove most existing wells which could be replaced by more productive wells into deeper aquifers. Lowered water levels temporarily could extend as much as three miles downgradient to the north. No significant changes in quantity or quality of surface water are anticipated. Sedimentation ponds could be left to replace destroyed stock ponds. Water requirements could be obtained from Fort Peck Reservoir several miles to the northeast.

Otter Creek Study Site Coal Resource and Surface Mining Potential Reclamation
Evaluation in the Otter Creek Coal Field, southeastern Montana
BLM, Denver, Colorado
EMRIA Report No. 1-75

The Otter Creek Coal Field underlies a dissected ridge sloping westward to the Otter Creek Valley, and is bounded on the north and south by Home and Threemile Creeks, intermittent tributaries to Otter Creek. Coal occurs chiefly as the 60-foot thick Knoblock bed, in thin beds above, and as the 10-foot thick Flowers-Goodale bed, 120 feet below the Knoblock, all in the Tongue River member of the Eocene age Fort Union Formation. The recoverable resource, the Knoblock coal, is covered by less than 200 feet of overburden, and can be surface-mined. Small quantities of poor quality unconfined water occur in thin sandstone and coal beds above the Knoblock coal. Slightly better quality water occurs in the coal. Yields to wells in these shallow aquifers are generally less than 10 gallons per minute and may not be sustainable for many uses. Confined water occurs about 150 feet below the Knoblock coal, and in various deeper aquifers, including those in the Madison Group, about 8,000 feet below land surface. Potential yields range from low in the shallower confined aquifers, to moderately high (several hundred gallons per minute) in the Madison. Potentiometric heads of deeper aquifers may be about 300 feet above land surface. Water quality is poor, ranging from more than 1,000 to as much as 6,000 milligrams per liter of total dissolved solids. Surface mining would dewater as much as 60 feet of saturated coal, affecting 6 stock wells. Special practices would prevent increased stream sedimentation. Water needed for operation could be obtained from impounded good-quality runoff supplemented by poorer quality ground water.

Pumpkin Creek Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in the Pumpkin Creek Coal Field, southeastern Montana
BLM, Denver, Colorado
EMRIA Rept. No. 11-78

The Pumpkin Creek site consists of 17 square miles of the Pumpkin Creek Coal Field, part of the Coalwood Coal Field in the northern Powder River Basin, southeastern Montana. Its semi-badland upland areas of buttes and steep, rocky outcrops drain by ephemeral tributaries to intermittent Pumpkin Creek on the northwest, Mizpah Creek on the southeast--eventually to the Yellowstone River via the Tongue River. Maximum refief from the bounding creeks to the elongate drainage divide is 350 feet. Annual precipitation is 13.8 inches. Nearly 1,370 million tons of coal in beds more than 5 feet thick are covered by less than 200 feet of overburden. Most runoff is intercepted for irrigation and stock watering by ditches and small reservoirs. The coal is in the lower Tongue River Member of the Fort Union Formation and consists of Sawyer, Mackin-Walker and A beds. Small amounts of perched, unconfined and semi-confined water was found sporadically in the coals and intervening and overlying discontinuous sandstone layers. Dissolved solids ranged from 397 to 4,340 milligrams per liter. The Lebo Shale Member, lower Fort Union Formation, hydraulically isolates the shallow aquifers from lower aquifers. Surface mining would dewater the shallow aquifer, and remove 6 wells, 3 springs, and 12 perennial and 25 ephemeral reservoirs.

West Decker Coal Lease Application, Decker, Montana
BLM, Miles City, Montana
DTEEA, 1979

This action would lease to the Decker Coal Company 440 acres of Federal coal, 160 acres of which would be surface-mined as an extension of its existing operations, and would provide access to an additional 11 million tons of coal. The mine is four miles northeast of Decker, Montana, and 21 miles northeast of Sheridan, Wyoming. The lease area consists of steep-sloped ridges adjacent to gentle slopes, draining ephemerally by ditches to intermittent Pond and Pearson Creeks. Annual runoff range is from 0.2 to 0.4 inches. The coal, in the Tongue River Member of the Paleocene Fort Union Formation, is about 52 feet thick, and dips slightly eastward into the Powder River Basin. The coals yield adequate water for domestic and stock use near the area, but no wells exist on the site. Depth to water in an observation well less than one-half mile from the site was 1,818 feet. Dissolved solids in two nearby wells were 1,529 and 1,621 milligrams per liter. Dissolved solids in nearby creeks ranged from about 1,200 milligrams per liter at high flow to about 2,500 milligrams per liter at low flow. The proposed mining in the application area would have no erosion or sedimentation impact in addition to that occurring from existing mining operations. Surface water quality should be as good if not better than pre-mined conditions. Occurrence and flow of ground water in the mine spoils would not be significantly different from pre-mined conditions. Spoil water would contain three times the dissolved solids of nearby ground water but would be acceptable for livestock.

Western Energy Coal Lease Modification, southeast Montana
BLM, Miles City, Montana
EA, 1976

This analysis evaluates impacts of allowing surface mining of 320 acres containing 12.6 million tons of recoverable Federal coal that otherwise would be by-passed. The mine area is immediately west of Colstrip and 36 miles south of Forsyth, Montana. The general area includes buttes, mesas, dissected plateaus and long narrow divides. The lease modification area is similar but lacks ridges and buttes, and its relief is only about 200 feet. Runoff from annual precipitation drains through normally dry gullies to East Fork Armello Creek. The recoverable coal, the Rosebud seam in the the Tongue River Member of the Paleocene Fort Union Formation, averages 24 feet thick and is covered by less than 150 feet of sandstone, thin shale and coal layers. Little or no water occurs in the Rosebud seam or above. Productive aquifers occur beneath the Rosebud. No wells exist in the lease modification area. Mining of the lease modification area would not significantly increase impacts to water resources.

Sierra Pacific Power Company Proposed 500 Megawatt Coal Fired Generating
Station, North Valmy, Nevada
BLM, Reno, Nevada
FES, 1978

This statement analyzes the impacts of pumping 7,660 acre feet per year (4,730 gallons per minute) of water from Humbolt River alluvium, which is more than 1350 feet thick in places, for operation of two coal-fired electric generating plants. Sources of the 1.4 million tons per year of coal are existing underground mines in Fishlake National Forest, Sevier County, Utah. Water for the first of two generating units would be from a line of wells extending as much as 15 miles from the plant along the southeast side of the river. Each well is expected to produce 500 to 3,000 gallons per minute. Annual recharge in this area is estimated to be 72,000 acre feet per year. Fresh (total dissolved solids in 5 test holes ranged from 241 to 631 milligrams per liter) water occurs in the upper part of the alluvium and is isolated from the river by layers of silt and clay. The applicant would assume responsibility for mitigating impacts to the two nearby wells in Valmy. Water for the second unit would be obtained from a well field about 10 miles east of the plant. Pumping from the second well field may affect irrigation wells more than two miles away. No impact to Battle Mountain wells is anticipated. Solid waste deposits (ash) and lined evaporation ponds for cooling tower blowdown are effectively isolated from ground water by relatively impermeable layers of silt and clay.

WATER RESOURCES OF NEW MEXICO, OCCURRENCE, DEVELOPMENT AND USE

BALANCE, W. C.; SORENSON, EARL F.; TITUS, F. B.; BORTON, R. L.; MOURANT, W. A.

STATE PLANNING OFFICE, SANTA FE, NEW MEX.; AND GEOLOGICAL SURVEY, WASHINGTON, D. C.

N MEX STATE PLANNING OFFICE REP, 1967. 321 P, 46 FIG, 4 PLATE, 63 TAB, 229 REF.,

Journal Announcement: SWRA0211

NEW MEXICO'S WATER RESOURCES AND WATER RESOURCE DEVELOPMENT ARE DESCRIBED. THE WATER LAW OF THE STATE IS BASED ON PRIOR APPROPRIATIONS TO ENSURE ORDERLY DEVELOPMENT. THE UTILIZATION OF WATER, STREAMFLOW, GEOLOGY, GROUNDWATER HYDROLOGY, SETTLEMENT AND HISTORY, ECONOMICS, AGRICULTURE, MINING, AND WATER PROBLEMS OF THE STATE ARE DESCRIBED IN REPORTS ON EACH OF THE STATE'S DRAINAGE BASINS. THE AREAS DISCUSSED IN DETAIL ARE THE ARKANSAS RIVER BASIN, PECOS RIVER BASIN, CENTRAL CLOSED BASINS, RIO GRANDE BASIN, WESTERN CLOSED BASINS, SAN JUAN RIVER BASIN, LOWER COLORADO RIVER BASIN, AND SOUTHWESTERN CLOSED BASINS. (KNAPP-USGS)

STRUCTURE AND STRATIGRAPHY IN THE VICINITY OF THE SHELL OIL CO. SANTA FE PACIFIC NO. 1 TEST WELL, SOUTHERN SANDOVAL COUNTY, NEW MEXICO

BLACK, B. A.; HISS, W. L.

GEOLOGICAL SURVEY, ALBUQUERQUE, N. MEX.

NEW MEXICO GEOLOGICAL SOCIETY GUIDEBOOK, 25TH FIELD CONFERENCE, GHOST RANCH (CENTRAL-NORTHERN NEW MEXICO), P 365-370, 1974. 4 FIG, 2 PLATE, 2 TAB, 13 REF.,

Journal Announcement: SWRA0803

THE STRATIGRAPHIC SECTION BENEATH THE SANTA FE GROUP IN THE NORTHERN PART OF THE ALBUQUERQUE-BELEN BASIN, NEW MEXICO, WAS OBTAINED FROM A WILDCAT OIL-TEST WELL. A GENERALIZED GEOLOGIC SECTION EXTENDING APPROXIMATELY 60 MILES FROM THE RIO PUERCO ON THE WEST ACROSS MESA PRIETA AND TERMINATING IN THE CERILLOS HILLS IS SHOWN. THE POTENTIAL FOR DEVELOPMENT OF ADDITIONAL OIL, GAS, URANIUM, COAL, GEOTHERMAL, AND GROUNDWATER RESOURCES MAKES THE GEOLOGIC UNDERSTANDING OF THIS AREA NOT ONLY OF ACADEMIC INTEREST BUT ALSO OF GREAT ECONOMIC IMPORTANCE FOR THE FUTURE OF NEW MEXICO. (KNAPP-USGS)

Effects of uranium development on erosion and associated sedimentation in southern San Juan Basin, New Mexico

Cooley, M. E., 1979

U.S. Geological Survey Open-File Report 79-1496, 25 p.

GEOLOGY AND GROUND-WATER OCCURRENCE IN SOUTHEASTERN MCKINLEY COUNTY, NEW MEXICO

COOPER, JAMES B.; JOHN, EDWARD C.

US GEOLOGICAL SURVEY.
N MEX STATE ENG TECH REP 35, 108 P, 1968. 7 FIG, 2 PLATE, 5 TAB, 58 REF.,
Journal Announcement: SWRA6802

GEOLOGIC CONDITIONS AND THE GENERAL AVAILABILITY AND CHEMICAL QUALITY OF GROUNDWATERS IN SOUTHEASTERN MCKINLEY COUNTY, NEW MEXICO ARE DESCRIBED WITH PARTICULAR EMPHASIS ON AREAS WHERE LARGE BODIES OF URANIUM ORES ARE PRESENT. THE PRINCIPAL AQUIFERS, THEIR AREAL EXTENT, AND THEIR AREAS OF DISTINCT AQUIFERS, MOSTLY ARTESIAN, IN ROCKS THAT RANGE IN AGE FROM PERMIAN TO QUATERNARY. YIELDS OF 300 GPM ARE OBTAINED FROM WELLS THAT TAP AQUIFERS IN THE GLORIETTA SANDSTONE AND SAN ANDRES LIMESTONE. GROUNDWATER IN ADEQUATE QUANTITIES AND OF USABLE QUALITY FOR STOCK AND DOMESTIC USE IS AVAILABLE THROUGHOUT SOUTHEASTERN MCKINLEY COUNTY. URANIUM MINES DISCHARGE MILLIONS OF GALLONS OF WATER; SOME OF THE WATER IS USED IN THE MILLS, BUT MOST OF IT IS PUMPED TO WASTE. GROUNDWATER ASSOCIATED WITH THE URANIUM DEPOSITS IS SLIGHTLY RADIOACTIVE. SEVERAL SAMPLES FROM MINES OR WELLS CONTAINED CONCENTRATIONS OF RADIUM SOMEWHAT ABOVE THE RECOMMENDED MAXIMUM LIMIT FOR DRINKING WATER. RECHARGE TO AQUIFERS IN SOUTHEASTERN MCKINLEY COUNTY IS MAINLY FROM PRECIPITATION ON OUTCROPS OF THE ROCKS AND FROM WATER ALONG FAULT ZONES.

Preliminary Data Report for the San Juan Basin-Crownpoint Surveillance Study
Frenzel, P. F.; Craigg, S. D.; Padgett, E. T.
Geological Survey, Albuquerque, NM. Water Resources Div.
Available from OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $10.50 in paper copy, $6.00 in microfiche. Geological Survey Open-File Report 81-484, March, 1981. 33 p, 4 Fig, 5 Plates, 3 Tab, 4 Ref.,
Journal Announcement: SWRA1420

Geohydrologic data that may be used to predict the effects of mining on Navajo water resources in the San Juan structural basin are reported as well as the current availability of data from other government agencies. Emphasis is on the vicinity of Crownpoint, New Mexico. (USGS)

Estimates of vertical hydraulic conductivity and regional ground-water flow rates in rocks of jurassic and cretaceous age, San Juan Basin, New Mexico and Colorado
Frenzel, Peter F., and Lyford, Forest P.
U.S. Geological Survey Water-Resources Investigations 82-4015

The San Juan structural basin in northwestern New Mexico was modeled in three dimensions using a finite-difference, steady-state model. The modeled space was divided into seven layers of square prisms that were 6 miles on a side in the horizontal directions. In the vertical directions, the layers of prisms ranged in thickness from 300 to 1,500 feet. The model included the geologic section between the base of the Entrada Sandstone and the middle of the Lewis Shale. Principal aquifers in this section are mostly confined and include the Entrada Sandstone, the Westwater Canyon Member of the Morrison Formation, and the Gallup Sandstone in the lower part of the Mesaverde Group.

Values for vertical hydraulic conductivities from 10 exp(-12) to 10 exp(-11) feet per second for the confining layers gave a good simulation of head differences between layers, but a sensitivity analysis indicated that these values could be between 10 and 100 times greater. The model-derived steady-state flow was about 30 cubic feet per second. About one-half of the flow was in the san Juan River drainage basin, about one-third in the Rio Grande drainage basin, and one-sixth in the Puerco River drainage basin.

Preliminary analysis of historical streamflow and water-quality records for the San Juan River Basin, New Mexico and Colorado

Goetz, Carole L

U.S. Geological Survey Special Publication No. 10, 1981, pp. 21-25.

The San Juan River, the second largest tributary to the Colorado River, originates on the west slope of the Continental Divide in southwestern Colorado and flows westward through Colorado, New Mexico, Arizona, and Utah.

Long-term streamflow and water-quality records are available at the U.S. Geological Survey gaging station, San Juan River at Shiprock, New Mexico. Mean values were calculated for daily measurements of streamflow, specific conductance, water temperature, sediment concentration, and sediment load for the period prior to 1963 and the period since 1963. The t-test procedure was used to compare the pre-1963 mean and post-1963 mean. Results show the means of daily streamflow and sediment load measurements for the San Juan River at the Shiprock gaging station have decreased for the post-1963 period, due in part to the effects of Navajo Reservoir. Other causes for this decrease may be related to increasing population, changes in agricultural irrigation, increased industrialization, climatic conditions, or a combination of these factors. The time-weighted mean of daily specific-conductance measurements appears to have decreased for the post-1963 period, but the reason for this change is not apparent. The discharge-weighted mean of daily specific-conductance measurements has increased for the post-1963 period. The means of daily water temperature and sediment concentration are not statistically different for the two time periods.

Hydrologic Investigations and Data-Collection Network in Strippable Coal Areas in Northwestern New Mexico

Hejl, H. R. Jr

Geological Survey, Albuquerque, NM. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $4.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-358, January

1982. 32 p, 5 Fig, 4 Tab.,

Journal Announcement: SWRA1605

This report presents hydrologic investigations and data collections conducted by the U.S. Geological Survey in the strippable coal areas of northwestern New Mexico. Streamflow, ground-water, and quality-of-water data were collected to provide information about baseline or prevailing hydrologic conditions. A network of hydrologic data-collection sites in the strippable coal areas of the Fruitland Formation was designed to meet the need of detailed investigations, including site-specific studies, and to provide hydrologic data in support of the expanding mining activity. The network consists of 34 continuous-record streamflow-gaging stations (32 included water-quality sampling), 20 miscellaneous water quality of streamflow stations, 12 annual maximum discharge stations, 27 observation wells completed in strata associated with the strippable coal seams, and 24 observation wells completed in channel alluvium downstream from strippable coal areas. (USGS)

Preliminary appraisal of ephemeral-streamflow characteristics as related to drainage area, active-channel width and soils in northwestern New Mexico

Hejl, H. R., 1981

U.S. Geological Survey Open-File Report 81-64, 15 p.

Regression equations are presented to predict ephemeral streamflow characteristics in the San Juan Basin in northwestern New Mexico. The standard error of estimate for predicting runoff for water year 1978 using drainage area as the independent variable was 152 percent. Indications are that reliable equations for predicating annual runoff can be developed and the standard error of estimate might be reduced significantly with additional years of record. The coefficient of regression when relating drainage area to runoff for water year 1978 was significant at the 1-percent level. Preliminary results also indicate it is feasible to predict streamflow characteristics using hydrologic soil-group classifications based on runoff potential. The standard error of estimate for predicting peak discharges with recurrence intervals of 2, 5, 10, 25, 50, and 100 years using active-channel width as the independent variable averaged about 50-percent, and the regression coefficient was significant at the 1-percent level. Using drainage area to predict peak discharges resulted in a standard error of estimate that averaged about 60 percent and a regression coefficient significant at the 5-percent when active-channel width and drainage area were related to peak discharges in multiple regression analyses.

INTERPRETATION OF GEOLOGIC AND HYDROLOGIC DATA FROM THE RAY-1 WELL, CITY OF GALLUP, MCKINLEY COUNTY, NEW MEXICO

HISS, W. L.; MARSHALL, J. G.

GEOLOGICAL SURVEY, ALBUQUERQUE, N. MEX.
OPEN-FILE REPORT 75-573, NOVEMBER 1975. 58 P, 3 FIG, 1 TAB, 4 REF.,
Journal Announcement: SWRA0909

THE RAY-1 WELL WAS TO BE THE THIRD PRODUCTION WELL COMPLETED IN THE CITY OF GALLUP, N. MEX., YAH-TA-HEY WELL FIELD LOCATED ABOUT 7 MILES (11 KM) NORTH OF THE CITY. THE FIRST STRING OF CASING COLLAPSED DURING COMPLETION, HOWEVER, AND THE WELL WAS ABANDONED BEFORE IT COULD BE TESTED. THE LITHOLOGY OF THE UPPER CRETACEOUS DALTON SANDSTONE AND DILCO COAL MEMBERS OF THE CREVASSE CANYON FORMATION AND THE GALLUP SANDSTONE WAS INTERPRETED FROM GEOPHYSICAL LOGS AND EXAMINATION OF THE DRILL CUTTINGS. THESE UNITS APPEAR TO BE SIMILAR TO CORRELATIVE STRATA ENCOUNTERED IN THE FIRST TWO WELLS. A YIELD OF APPROXIMATELY 700 GPM, SIMILAR TO THE OTHER WELLS IN THE YAH-TA-HEY WELL FIELD, IS ANTICIPATED FROM THE SAME AQUIFERS WHEN THE RAY-1 REPLACEMENT WELL IS COMPLETED. (WOODARD-USGS)

Coal Resources of the Raton coal field, Colfax County, New Mexico
Lee, W. T., 1924
U.S. Geological Survey Bulletin 752, 254 p.

Ground Water in the San Juan Basin, New Mexico and Colorado
Lyford, Forest P.
U.S. Geological Survey, WRI 79-73

Principal aquifers in the San Juan Basin of New Mexico and Colorado are the Entrada Sandstone, Westwater Canyon Member of the Morrison Formation, Gallup Sandstone of the Mesaverde Group, several sandstones in the Mesaverde Group above the Gallup (Dalton Sandstone Member of the Crevasse Canyon Formation, Point Lookout Sandstone, Menefee Formation, Cliff House Sandstone), and sandstones of Tertiary age.

Mose ground water flows from topographically high outcrop areas toward the San Juan River and Rio Grande valley. Much of the water may move through confining layers to other aquifers or to the land surface rather than discharging directly to the streams.

Transmissivities of the sandstones range from 50 to 300 feet squared per day. Lowest dissolved-solids concentrations occur in or near outcrops of the sandstones and increase in the direction of ground-water flow. Concentrations range from less than 500 milligrams per liter to more than 30,000 milligrams per liter.

Methodology for Hydrologic Evaluation of a Potential Surface Mine: The Tsosie Swale Basin, San Juan County, New Mexico
Shown, L. M., Frickel, D. G., Hadley, R. F., and Miller, R. F.
U.S. Geological Survey WRI Open-File Report 81-74

Permit applications made to the Office of Surface Mining Reclamation and Enforcement for mining of near-surface coal deposits contain both mining and reclamation plans. These plans must be evaluated by regulatory authorities for compliance with the permanent regulations of the Surface Mining Control and

Reclamation Act of 1977. Methodologies for assessment of the effects of mining and reclamation on the hydrologic system are presented for a potential permit area of 640 acres in the Tsosie Swale basin, a small tributary of Escavada Wash in northwestern New Mexico. Escavada Wash is the principal tributary of the upper Chaco River, which is the stream that drains much of the San Juan structural basin. Tsosie Swale represents an arid climatic area and a low relief landscape with a sandy mantle that is moderately vegetated with shrubs and grasses.

Premining soils, vegetation, geology, and hydrology of Tsosie Swale are described as a basis for evaluation of changes that may occur. Soil-moisture-vegetation relations show that the most grass cover occurs where 1 to 2 feet of sandy surface soils are underlain by fine-textured, less-permeable layers that perch soil moisture.

Estimates are made of premining and postmining peak discharges and runoff volumes by the empirical Soil Conservation Service (SCS) method and by a basin-characteristic model. The SCS method was found to be superior because it considers infiltration rates. Postmining peak discharge estimates are 30 to 70 percent of premining estimates, and runoff volumes are 30 to 70 percent of premining values.

Methods are demonstrated for estimating soil loss by use of the Universal Soil Loss Equation (USLE) and by simulation of an intense rainstorm on a microwatershed. Estimates of sediment yield from the basin for premining conditions are made using reservoir-sedimentation surveys and a watershed-factor rating method. USLE soil-loss estimates and a sediment delivery ratio is used to estimate postmining sediment yield. Estimated postmining sediment yield is about 50 percent of the premining estimate.

Changes in the topography resulting from removel of coalbeds and expansion of the overburden are shown to vary from a lowering of part of the permit area as much as 20 feet, to raising of other parts as much as 20 feet. The primary factors responsible for the reductions in streamflow and sediment yield are the assumptions that the minor areas now consisting of badlands and alluvial plains, from which runoff is high, would be eliminated, and the whole area would be covered with about 2 feet of sandy soil.

Hydrogeology and water resources of San Juan Basin, New Mexico

Stone, William J., Lyford, Forest P., Frenzell, Peter F., Mizell, Nancy H., Padgett, Elizabeth T.

New Mexico Bureau of Mines and Mineral Resources, Prepared in cooperation with the Geological Survey. Hydrologic Report 6.

The San Juan Basin of northwest New Mexico contains a wealth of energy resources. Although petroleum reserves are nearly depleted, vast reserves of uranium and coal remain to be extracted. In this arid to semiarid region, surface-water resources are limited and fully appropriated. New water supplies for energy development and growing muncipalities must, therefore, be derived from negotiated surface water or ground water. Major aquifers include Quaternary valley fill and sandstones of Tertiary, Cretaceous, Jurassic, and Triassic age. Ground water in these aquifers is generally confined, but some interaquifer leakage occurs; transmissivities between 100 ft2/d and 200 ft2/d are characteristic. Specific conductance of ground waters is variable (less than 500 umhos to more than 30,000 umhos). Regional flow is from elevated recharge areas on the basin margin toward discharge areas along the San Juan River in the northwest and along the Rio Puerco in the southeast. Occurrence, movement, and quality of ground water are subject to considerable geologic control provided by the distribution and characteristics of the sandstone aquifers, geologic structure, and regional stratigraphy. The principal uranium orebody is also a regional aquifer. Uranium-mine dewatering has caused water-level declines; greater declines will accompany construction of deeper mines. Post-mining persistence of toxic substances is unknown, but such material may remain near the mine cavity because of local geochemical conditions. Water is not generally encountered in strip mining; supply is the major water problem in coal development. Potential sources of water include deep aquifers, excess uranium-mine effluent, and Tertiary sandstone aquifers in areas adjacent to the coal belt. Impacts of return flow from the Navajo Indian Irrigation Project on San Juan River quality may be difficult to distinguish from impacts of energy development and municipal activities. Irrigated acreage in river valleys is expected to decrease as water rights are transferred to other uses, such as energy development. Future water needs of municipalities, growing in response to energy development, may be met in some areas by tapping deeper aquifers and in others by obtaining uranium-mine effluent. Water treatment may be required in both cases.

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico

Summer, R. M.

Geological Survey, Denver, CO. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-195744, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-44, 1981. 33 p, 10 Fig, 9 Tab, 31 Ref.,

Journal Announcement: SWRA1511

Onsite rainfall-simulation experiments were conducted to derive field-erodibility indexes for rangeland soils and soils disturbed by mining in coal fields of northwestern New Mexico. Mean indexes on rangeland soils range from 0 grams (of detached soil) on dune soil to 121 grams on wash-transport zones. Mean field-erodibility-index values of soils disturbed by mining range from 16 to 32 grams; they can be extrapolted to nearby coal fields where future mining is expected. Because field-erodibility-index data allow differentiation of erodibilities across a variable landscape, these indexes were used to adjust values of K, the erodibility factor of the Universal Soil Loss Equation. Estimates of soil loss and sediment yield were then calculated for a small basin following mining. (USGS)

Techniques for Estimating Flood Discharges for unregulated Streams in New Mexico
Thomas, Richard P., and Gold, Robert L.
U.S. Geological Survey WRI, 82-24.
Equations for estimating flood magnitudes at selected recurrence intervals from 2 to 500 years were developed using multiple-regression analyses. These equations relate flood magnitudes to basin characteristics, contributing drainage area, and site altitude, and only are applicable to unregulated streams in New Mexico that are relatively unaffected by urban runoff. Flood estimates at gaged sites are computed using a separate estimating equation. This equation adjusts discharges developed from the original regression equations using flood magnitude and frequency values at the gaged site.

Environmental impact statement of proposed Prewitt-Star Lake railroad branch line and Star Lake coal mine, section on water resources
U.S. Geological Survey, 1976
Draft Administrative Report, 84 p.

Geology and fuel resources of the southwestern part of the Raton coal field, Colfax County, New Mexico
Wanek, A. A., 1963 (1964)
U.S. Geological Survey Coal Investigations Map C-45, scale 1:48,000, 2 sheets.

Bibliography of Geology and Hydrology, Southwestern New Mexico
Wright, A. F.
Geological Survey, Albuquerque, NM. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-199961, Price codes: A12 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-20, January 1980. 255 p, 1 Fig.,
Journal Announcement: SWRA1401
The southwestern part of New Mexico is recognized as a source of abundant and varied natural resources. This bibliography of over 2,700 references concerned with geology, hydrology, chemistry, and geography has been compiled to assist physical science researchers in their study and development of this region. (USGS)

### Bisti West Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in the Bisti Coal Field, San Juan County, northwestern New Mexico

BLM, Denver, Colorado
EMRIA Report No. 5-76

Most of the Bisti 4-square-mile site in the San Juan Basin is a 50-foot-per-mile sloping, sandy plain dissected by dry washes. It is bounded on the northwest by the 100-foot escarpment of Alamo Mesa. Soils are thin, poor, and in places absent. Vegetation is primarily northern desert shrub having low vegetative yields. Large amounts of ground are bare. Measured cover ranges from 5.7 to 57 percent. Coal is found in the northwestward dipping Cretaceous Fruitland Formation on the southwest side of the Basin. More than 81 million tons of coal occur in beds thicker than 2.5 feet less than 200 feet beneath the site. Annual precipitation is 8 inches and annual evapotranspiration is about 50 inches. Runoff from the site may range between 22 and 54 acre-feet annually. The little water that occurred in the coal and in layers above contained 3,000 to 4,000 milligrams per liter of total dissolved solids. Water in deeper aquifers below the coal is too saline for irrigation, except for the Morrison Formation where water containing less than 1,000 milligrams per liter of total dissolved solids and yielding 500 gallons per minute has been found. Water for operation could be purchased and pipelined at least 8 miles, possibly supplemented by ground water or impounded local runoff. Normal water-handling and restoration practices would minimize or prevent erosion, sedimentation and water-quality deterioration.

### Coal Preference Right Leasing, New Mexico

BLM, Albuquerque, New Mexico
FEA, 1981

The proposed action is to lease 75,510 acres in northwestern New Mexico for 26 Preference Right Leases to mine coal. About 22,000 acres would be surface mined and about 26,650 acres would be mined underground. The area is in the south-central part of the San Juan Basin and consists of west-southwest sloping poorly dissected, moderately rolling plain. Isolated steep-sided mesas and buttes and badlands remain in places. The area is underlain by the nearly flat-lying sedimentary upper Cretaceous Kirtland and Fruitland Formations. About 1.9 billion tons of recoverable coal in the lower Fruitland Formation underlie eight of the 13 townships in the area. Data is inadequate to quantify reserves in the remaining 5 townships. The climate is semiarid. Annual precipitation ranges from 8 to 11 inches and the annual moisture deficit ranges from about 10 to 14 inches. All drainages in the area are ephemeral. Drainage west of the Continental Divide is to Chaco Wash and to the Colorado River. The small part of the area east of the Divide drains to

Torreon Wash and to the Rio Grande via Rio Puerco. Numerous ephemeral stock ponds and four playa lakes furnish water for stock and wildlife when water is present. Small quantities of water occur in shallow sandstone layers and is frequently under artesian pressure. Larger quantities are found in deeper sandstones, also under pressure. Quality ranges from good (less than 1,000 milligrams per liter total dissolved solids) at some places in the Morrison formation, 5,000 to 6,000 feet deep, to poor (more than 2,000 milligrams per liter total dissolved solids) in other deeper formations. Depending on reclaimed surface treatment, infiltration could increase and runoff reduce, or the opposite could occur. Surface mining could destroy as many as 23 shallow domestic and stock wells. Water quality in 16 of the wells ranged from 2,000 to 17,000 milligrams per liter total dissolved solids.

Kimbeto Study Site Coal Resource and Surface Mining Potential Reclamation
Evaluation in San Juan County, northwestern New Mexico
BLM, Denver, Colorado
EMRIA Report No. 17-77.

The 19 square-mile Kimbeto study area in the southwest part of the Central San Juan Basin consists of badlands, boldly scarped mesas, and sand dunes. It is drained by three sand-choked ephemeral dry washes originating miles upstream. Relief is about 260 feet and annual precipitation is 8.8 inches. Surficial deposits are underlain by the Cretaceous Kirtland (shale) Formation and the Fruitland Formation. The Fruitland contains 61.6 million tons of coal in several beds more than 2.5 feet thick covered by less than 400 feet of overburden beneath the site. Most runoff from the site derives from the shale badlands. Water in the alluvium may yield as much as 50 gallons per minute of moderately mineralized (about 1,500 milligrams per liter dissolved solids) water to wells. Larger quantities of water is available from deeper aquifers more than 1,000 feet below the coal but mineralization increases with depth to as much as 14,000 milligrams per liter dissolved solids at 6,000 feet below land surface. Mining would temporarily impact current water uses--livestock grazing and wildlife--and downstream flow by increased infiltration in reclaimed areas. Water supply for operation, and irrigation, if needed, would be a combination of ground water and stored surface water.

Ojo Encino Study Site Coal Resource and Surface Mining Potential
Reclamation Evaluation in McKinley County, northwestern New Mexico
BLM, Denver, Colorado
EMRIA Report No. 19-78

The 6.4 square-mile Ojo Encino site in the southeastern part of the San Juan Basin consists of low hills and gently rolling terrain. Relief is about 120 feet. The site is ephemerally drained by southeast trending dry washes. Coal is in the lower part of the late Cretaceous Fruitland Formation. The Fruitland Formation contains 133 million tons of coal in three beds ranging in thickness from 5 to 21 feet, covered by less than 300 feet of overburden. No water was encountered in the overburden. Coal seams and interbedded sandstone could yield up to 20 gallons per minute of water containing about 2,400 milligrams per liter of dissolved solids. Several hundreds of gallons per minute of moderately saline water, specific conductance ranging from 2,000 to 15,000 micromhos, can be obtained in deeper aquifers from 500 to 6,500 feet below land surface. No long term adverse effects are expected from surface mining.

Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town
BLM, Santa Fe, New Mexico
DEIS, 1982

This EIS evaluates the impacts of constructing and operating a 2,000 megawatt coal-fired steam electric generating station in San Juan County in northwestern New Mexico, and a possible new town. Impacts of surface mines to be developed nearby in the San Juan Basin for the source coals (9 million tons per year) are not discussed. The proposed action would require 35,000 acre feet per year (48 cubic feet per second) of water from the Navajo Reservoir to be taken from the San Juan River, either at Farmington or 14 miles upstream at Bloomfield. Average annual flow and minimum flow are 2,400 and 700 cubic feet per second at Farmington. During drought, an additional 48 cubic feet per second would be released from the Navajo Reservoir. Water quality decreases downstream--total dissolved solids of 266 milligrams per liter at Bloomfield and 449 at Shiprock, 35 miles downstream. Salinity would increase 4 milligrams per liter at Imperial Dam. An alternative would produce 15,000 acre-feet per year of the required water from 16 wells in the Westwater Canyon Member of the Morrison Formation, 4,000 to 6,000 feet below the surface. Water quality ranges from 500 to 4,500 milligrams per liter in this aquifer. A mathematical model predicted 25-foot drawdowns would extend throughout the basin, and into Colorado through the year 2109. Pumping would cause an unquantifiable amount of subsidence and reduce flow in the Chuska Mountains springs, and by 0.09 cubic feet per second in the San Jose and Puerco Rios and the San Juan and Puerco Rivers. Mitigation could be by replacement, improvement, or payment of added water costs. This alternative would reduce salinity increase in the Colorado River and lessen dewatering of existing and future uranium mines in the Basin. The proposed new town would require 4,550 acre-feet per year (2,800 gallons per minute) of water, probably from the Westwater Canyon Member of the Morrison Formation, which is about 5,000 feet below the new town near Bisti. More detailed information is in Geologic Setting, Mineral Resources, Hydrology and Water Quality Technical Reports.

San Juan Action Plan, northwestern New Mexico
BLM, Santa Fe, New Mexico
TR, Hydrology, 1982

This report analyzes the impacts of consumption by the proposed 2,000 megawatt electric generating plant, of 35,000 acre-feet per year from the Navajo Reservoir on the San Juan River, in northwest New Mexico and the alternate of obtaining only 20,000 acre-feet per year from the Reservoir and 15,000 acre-feet per year from wells in the Upper Jurassic Westwater Canyon Member of the Morrison Formation. After a comprehensive review of the various compacts, legislative acts, and the treaty with Mexico governing the administration of Colorado River Basin waters, the report concludes that an additional annual withdrawal of 35,000 acre-feet would not affect New Mexico's ability to satisfy provisions of the compacts and that this withdrawal would not cause a shortage of water to present and projected water users in the San Juan River Basin. However, during drought (worst-case), the alternative upstream intake at Bloomfield would not take advantage of downstream irrigation return flows and the required additional releases from the Navajo Reservoir could conceivably reduce the carryover storage, which could result in shortages to United States rights. Any shortage would have to be shared proportionately among users. The impacts of the ground water alternative were predicted using the U.S. Geological Survey's finite difference computer model which accommodates 3-dimensional ground water flow. The model simulated the 5-layer "Westwater Canyon" aquifer system consisting of, from bottom, 1) the Entrada Sandstone aquifer, 2) a leaky aquifer layer including the Todilto Limestone gypsum member, 3) the Westwater Canyon Member aquifer of the Morrison Formation, 4) a leaky aquifer confining unit and 5) the Dakota Sandstone aquifer. The system is hydraulically isolated by the Mancos Shale above and the Chinle Formation below. Before the year 2188, the pumping would result in Westwater Canyon Member drawdowns of more than 2,500 feet near the well field, more than 2,000 feet in an area of 400 square miles, 1,000 feet over 900 square miles, and more than 400 feet over 2,000 square miles. Drawdowns of more than 400 feet in the Dakota Sandstone would extend over 900 square miles. Water level declines of more than 25 feet would affect 145 Westwater Canyon Member wells, 100 Dakota Sandstone wells, and 13 Entrada Sandstone wells. Natural discharge to the Rio Puerco, Rio San Jose, and the Puerco and San Juan Rivers would be reduced by a total of 0.09 cubic feet per second. The drawdowns would reduce the dewatering of uranium mines by less than 5 percent. This report supports: 1) the San Juan River Regional Coal Leasing EIS, 2) the Bisti, De-na-zin and Ah-shi-sle-pah Wilderness Study Areas EIS, and 3) the New Mexico Generating Station EIS.

San Juan Action Plan, northwestern New Mexico
BLM, Santa Fe, New Mexico
TR, Water Quality, 1982

The report assesses the water quality effects of consumption of 35,000 acre-feet per year of water from the San Juan River Navajo Reservoir by a proposed 2,000 megawatt coal-fired electric generating plant, 35 miles south of Farmington. An alternative would be to obtain 15,000 acre-feet per year from the Westwater Canyon Member of the Upper Jurassic Morrison Formation, and only 20,000 acre-feet from the reservoir. Construction of the river intake would have little or no effect on the suspended sediment load of the San Juan River. The U.S. Bureau of Reclamation Colorado River Simulation System was used to evaluate salinity impacts of the two levels of withdrawal at the year 2010, with and without proposed Colorado River system salinity control projects. Without the salinity control projects, the proposed annual withdrawals of 35,000 and 20,000 acre-feet would increase salinity at Imperial Dam by 0.39 and 0.22 percent over the baseline of 1,019 milligrams per liter. If the salinity control measures are implemented, the same withdrawals would increase salinity at Imperial Dam by 0.37 and 0.21 percent over an 859 milligram per liter base. The large drawdowns resulting from use of groundwater from the Westerwater Canyon Member could induce leakage of poorer quality water in adjacent aquifers and might increase its dissolved solids content by about 5 percent over present levels, which are now so high as to be unsuitable for stock watering. Although ground water usage would decrease flow by less than one percent in the San Juan River and Rio San Jose, salinity increase would be negligible. Runoff from evaporation ponds and waste sites could degrade shallow groundwater in the immediate vicinity of the plant.

San Juan River Regional Coal, northwestern New Mexico
BLM, Santa Fe, New Mexico
DEIS, 1982

The San Juan River Region is a low plateau that approximates the New Mexican part of the San Juan structural basin. It is characterized by subdued low mesas, buttes and broad cuestas. The continental divide extends southwesterly across the southern part of the region. The Chaco River drains most of the region to the northwest into the San Juan River (Colorado-Pacific drainage). The Puerco and Zuni Rivers drain a small area in the southwest, eventually to the Colorado River. A small area in the southeast drains by Arroyo Chico via Rio Puerco to the Rio Grande (Atlantic drainage). The San Juan River is the only perennial stream in the area, receiving most of its flow from the San Juan Mountains to the north in Colorado. Stream water quality ranges widely, both in time and from stream to stream. Annual precipitation ranges from 10 to 14 inches. The annual moisture deficit is 10 to

12 inches. Highly lenticular coal beds occur in the late Cretaceous Fruitland, Menefee and Crevasse Canyon Formations, overlain and underlain by layers of sandstone, shale and siltstone. The formations dip gently northward and crop out in concentric arcs on the basin's southern border. Small quantities of marginal quality water occur locally in the coal and in shallow aquifers above. Water in alluvium ranges from less than 1,000 milligrams per liter dissolved solids in headwaters to more than 2,000 milligrams per liter in downstream reaches. Several potential sandstone aquifers below the coals contain water ranging from less than 200 to more than 44,000 milligrams per liter of total dissolved solids. Surface mining, allowed by all alternatives, would disrupt shallow aquifers used mostly for stock watering. A series of maps shows predicted drawdowns in the deeper aquifers of the No Action Alternative and differences in drawdowns between this and four other alternatives through the year 2040.

Star Lake - Bisti Regional Coal
BLM, Albuquerque, New Mexico
FEIS, 1979

Anticipated coal and coal-related activities in the 4.8-million-acre Star Lake - Bisti region of northwestern New Mexico are discussed. The region includes the Chaco, Rio Puerco, and San Juan Planning Units administered by the Bureau of Land Management and encompasses parts of McKinley, Rio Arriba, Sandoval, and San Juan Counties. Potential coal production in the region is analyzed with respect to existing mines, coal development on existing Federal leases, coal development not requiring Federal authorization, and other related developments occurring or expected to occur within the region by 1990. At full implementation of Federal, state, and private actions, the region could produce 75 million tons of coal annually. Anticipated coal and coal-related development would alter the topography on 28,000 acres. Mining activities would require withdrawal of 59,000 acre-feet of groundwater annually. Each mine would discharge an estimated 13,700 tons of sediment annually, destroying many stream channels.

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Ground-Water Basic Data for Morton County, North Dakota
Ackerman, D. J.
Geological Survey, Bismarck, ND. Water Resources Div.
North Dakota County Ground-Water Studies 27--Part II, and North Dakota Geological Survey Bulletin 72--Part II, Bismarck, 1977. 592 p, 2 fig, 1 plate, 6 tab, 10 ref.,
Journal Announcement: SWRA1110

The purpose of this ground-water investigation in Morton County, N. Dak., was to determine the quantity and quality of ground water available for municipal, domestic, livestock, industrial, and irrigation uses. Specifically, the objectives were: (1) determine the location, extent, and nature of the major aquifers; (2) evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) estimate the quantities of water stored in the aquifers; (4) estimate the potential yields to wells tapping the aquifers; and (5) determine the chemical quality of the ground water. Most data in this report were collected between 1972 and 1975. All data-collection points are shown. The data consist of the following: (1) Geologic and hydrologic data for 1,209 wells, test holes, and springs; (2) water-level measurements for 148 observation wells; (3) lithologic and geophysical logs for 247 test holes and wells; (4) chemical analyses of 353 water samples; and (5) analyses of physical properties of 42 core samples. (Woodard-USGS)

Ground-Water Resources of Morton County, North Dakota
Ackerman, D. J.
Geological Survey, Bismarck, ND. Water Resources Div.
North Dakota County Ground-Water Studies 27--Part III, and North Dakota Geological Survey Bulletin 72-Part III, 1980. 51 p, 10 Fig, 3 Plates, 1 Tab, 37 Ref.,
Journal Announcement: SWRA1324

A study of the occurrence and characteristics of aquifers and the movement, quantity, and quality of water in aquifers in Morton County found that aquifers in the glacial drift and alluvium underlie only 10 percent of the county but have the greatest potential for large-scale development. These aquifers, composed of sand and gravel, occur in buried valleys and in major river valleys. In some localities yields may exceed 500 gallons per minute of water suitable for irrigation; however, where a hydraulic connection exists between bedrock and glacial-drift aquifers, large withdrawals of water from the glacial-drift aquifer will result in increased dissolved solids and percent sodium. Bedrock aquifers, consisting of very fine to fine-grained sandstones, yield less than 100 gallons per minute of water that is generally soft, moderately saline, and useful for domestic, livestock, and some industrial uses. The Fox Hills aquifer underlies all the county and is the most extensive and continuous bedrock aquifer. It is exposed in the southeastern corner of the county and lies at a depth of more than 1,500 feet in the northwestern corner of the county. Bedrock aquifers above the Fox Hills occur in the Hell Creek, Ludlow and Cannonball Formations undifferentiated, Tongue River, and Sentinel Butte Formations. (USGS)

Ground-Water Data for Billings, Golden Valley and Slope Counties, North Dakota
Anna, L. O.
Geological Survey, Bismarck, ND. Water Resources Div.
North Dakota County Ground-Water Studies 29--Part II, and North Dakota Geological Survey Bulletin 76--Part II, 1980. 241 p, 2 Fig, 1 Plate, 9 Tab, 25 Ref.,
Journal Announcement: SWRA1401

The purpose of the investigation in Billings, Golden Valley, and Slope Counties, ND., was to determine the availability and quality of ground water for municipal, domestic, industrial, and irrigation uses. Specifically, the objectives were to: (1) determine the location, extent, and nature of the major aquifers and confining beds; (2) evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) estimate the quantities of water stored in the aquifers; (4) estimate the potential yields of wells tapping the major aquifers; (5) determine the chemical quality of the ground water; and (6) estimate the water use. The data in this report were collected between 1974 and 1977. The data consist of the following; (1) Geologic and hydrologic records for 723 wells, test holes, springs, and miscellaneous data-collection sites; (2) water-level measurements in 48 observation wells; (3) lithologic and geophysical logs of 367 test holes and wells; (4) 273 chemical analyses of ground water; (5) 33 chemical analyses of surface water during low flow; (6) 18 chemical analyses of ground water for trace constituents; (7)9 chemical analyses of ground water for dissolved gases; (8) 62 analyses of core samples for hydraulic parameters and particle-size distribution; and (9) 29 analyses of core samples for heavy mineral content. (USGS)

Groundwater Resources of Billings, Golden Valley, and Slope Counties, North Dakota
Anna, L. O.
Geological Survey, Bismarck, ND. Water Resources Div.
North Dakota County Groundwater Studies 29--Part III, and North Dakota Geological Survey Bulletin 76--Part III, 1981. 56 p, 18 Fig, 1 Plate, 6 Tab, 69 Ref.,
Journal Announcement: SWRA1420

In Billings, Golden Valley, and Slope Counties, N. Dak., rocks within 2,200 feet of the land surface contain several aquifers that bear relatively fresh water. The aquifers, which are in rocks of Late Cretaceous and Tertiary age, consist of interbedded sandstone, siltstone, claystone, and lignite. The major aquifers in the three-county area are the Fox Hills-lower Hell Creek aquifer system, the upper Hell Creek-lower Ludlow aquifer system, and aquifers in the upper part of the Ludlow, Tongue River, and Sentinel Butte Members of the Fort Union Formation. The Fox Hills-lower Hell Creek aquifer system has a mean transmissivity of 313 feet squared per day and may yield as much as 300 gallons per minute of sodium bicarbonate type water. The other aquifers generally yield less water, but the water is also predominantly a sodium bicarbonate type. Withdrawals of water from flowing wells along the valley of the Little Missouri River have created a cone of depression and major deflection in the potentiometric surface of all the major aquifers. (USGS)

GEOLOGY AND GROUND WATER RESOURCES OF WILLIAMS COUNTY, NORTH DAKOTA: PART 3 - HYDROLOGY
ARMSTRONG, C. A.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
N DAK GEOL SURV BULL 48 AND N DAK STATE WATER COMM COUNTY GROUND WATER STUDIES 9, 1969. 82 P, 22 FIG, 2 PLATE, 2 TAB, 34 REF.,
Journal Announcement: SWRA0305

GROUNDWATER IN WILLIAMS COUNTY, NORTH DAKOTA, IS OBTAINED FROM AQUIFERS IN THE GLACIAL DRIFT OF QUATERNARY AGE, THE FORT UNION GROUP OF TERTIARY AGE, AND THE DAKOTA GROUP OF CRETACEOUS AGE. THREE OF THE MORE PRODUCTIVE AQUIFERS ARE THE LITTLE MUDDY, RAY, AND GRENORA; THESE AQUIFERS ARE COMPOSED OF SAND AND GRAVEL THAT WAS DEPOSITED IN THE ANCESTRAL YELLOWSTONE, LITTLE MISSOURI, AND MISSOURI RIVER VALLEYS, RESPECTIVELY. PROPERLY CONSTRUCTED WELLS IN THE MORE PERMEABLE PARTS OF THESE GLACIAL AQUIFERS CAN BE EXPECTED TO YIELD MORE THAN 500 GALLONS PER MINUTE. YIELDS OF MORE THAN 500 GPM ARE ALSO OBTAINABLE FROM THE MORE PERMEABLE PARTS OF THE TRENTON AND HOFFLUND AQUIFERS IN THE PROGLACIAL YELLOWSTONE AND MISSOURI RIVER VALLEYS. YIELDS OF 50 TO 500 GPM ARE OBTAINABLE FROM SOME OUTWASH AND BURIED GLACIOFLUVIAL DEPOSITS IN THE NORTHERN PART OF THE COUNTY AND FROM SOME OF THE FINER SAND DEPOSITS IN THE 5 MAJOR AQUIFERS. WATER FROM THE GLACIAL DRIFT AQUIFERS DIFFERS GREATLY IN QUALITY. GENERALLY IT IS VERY HARD AND OF A CALCIUM BICARBONATE TYPE. WATER IN THE FORT UNION GROUP CONSISTS OF 2 TYPES; A SOFT SODIUM BICARBONATE WATER, AND A HARD SODIUM SULFATE BICARBONATE WATER. GENERALLY IT IS TOO SALINE FOR HUMAN CONSUMPTION OR IRRIGATION. WATER FROM THE DAKOTA IS USED FOR PRESSURE MAINTENANCE IN OIL FIELDS, BUT IS TOO SALINE FOR MOST OTHER USES. (KNAPP-USGS)

GROUNDWATER RESOURCES OF BURKE AND MOUNTRAIL COUNTIES
ARMSTRONG, C. A.

GEOLOGICAL SURVEY, BISMARCK, N. DAK.
NORTH DAKOTA GEOLOGICAL SURVEY BULLETIN 55, PART III, AND NORTH DAKOTA WATER COMMISSION, COUNTY GROUNDWATER STUDIES 14, PART III, 1971. 86 P, 22 FIG, 4 PLATE, 1 TAB, 36 REF.,
Journal Announcement: SWRAU423

THIS INVESTIGATION WAS CONDUCTED TO DETERMINE THE QUANTITY AND QUALITY OF GROUNDWATER AVAILABLE IN BURKE AND MOUNTRAIL COUNTIES, NORTH DAKOTA. THE CHIEF SOURCE OF LOCAL GROUNDWATER IS FROM THE GLACIAL DEPOSITS OF THE NEW TOWN AND SHELL CREEK AQUIFER SYSTEMS IN MOUNTRAIL COUNTY, AND THE COLUMBUS AQUIFER IN BURKE COUNTY. THE NEW TOWN AQUIFER CONSISTS OF ABOUT 307 FEET OF SANDS AND GRAVELS WITH A YIELD OF ABOUT 500 GPM. WATER QUALITY VARIES FROM A HARD SODIUM BICARBONATE TO A HARD SODIUM SULFATE TYPE. THE SHELL CREEK AQUIFER COMPOSED OF GLACIAL OUTWASH HAS A YIELD OF 300 GPM. WATER QUALITY CHANGES WITH DEPTH FROM A HARD SODIUM SULFATE TO A HARD SODIUM SULFATE BICARBONATE TYPE. THE COLUMBUS AQUIFER COMPOSED OF GLACIO-FLUVIAL DEPOSITS IS DIVIDED INTO TWO ZONES SEPARATED BY GLACIAL TILL AND SILT. THE LOWER ZONE HAS WATER OF SODIUM BICARBONATE TYPE WHILE THE UPPER WATER IS A VERY HARD SODIUM SULFATE TO CALCIUM SULFATE TYPE. THE AQUIFER HAS A YIELD OF 200 GPM. LOCAL BEDROCK YIELDS ARE SMALL AND WATER FROM THESE UNDERLYING TERTIARY (PALEOCENE) AND CRETACEOUS BEDS ARE GENERALLY TOO SALINE TO BE USED FOR STOCK, IRRIGATION, OR FOR HUMAN CONSUMPTION. (GLASBY-USGS)

Lignite resources of North Dakota
Brandt, R. A., 1963
U.S. Geological Survey Circular 226, 78 p.

Ground-Water Data for Sheridan County, North Dakota
Burkart, M. R.
Geological Survey, Bismarck, ND. Water Resources Div.
North Dakota County Ground-Water Studies 32--Part II, and North Dakota Geological Survey Bulletin 75--Part II, 1980. 302 p, 2 Fig, 1 Plate, 4 Tab, 21 Ref.,
Journal Announcement: SWRA1324

The purpose of the investigation in Sheridan County, ND, was to determine the availability and quality of ground water for municipal, domestic, industrial, and irrigation uses. Specifically, the objectives were to: (1) determine the location, extent, and nature of the major aquifers; (2) evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) estimate the quantities of water stored in the aquifers; (4) estimate the potential yields of wells tapping the major aquifers; (5) evaluate the chemical quality of the ground water; and (6) estimate the water use. The data in this report were collected between 1976 and 1979. The data consist of the following; (1) Geologic and hydrologic records for 320 wells and test holes;

(2) water-level measurements in 61 observation wells; (3) lithologic and geophysical logs of 308 test holes and wells; and (4) chemical analyses of 93 ground-water samples. (USGS)

Groundwater Resources of Sheridan County, North Dakota
Burkart, M. R.
Geological Survey, Bismarck, ND. Water Resources Div.
North Dakota County Groundwater Studies 32--Part III, and North Dakota Geological Survey Bulletin 75--Part III, 1981. 32 p, 10 Fig, 3 Plates, 3 Tab, 17 Ref.,
Journal Announcement: SWRA1420

Groundwater in Sheridan County, N. Dak., is obtainable from aquifers in the upper Cretaceous bedrock and Quaternary glacial drift. Bedrock aquifers have a greater areal distribution, but those in the glacial drift provide a greater potential yield to individual wells. The major bedrock aquifers are the Fox Hills aquifer system and the Hell Creek-Fox Hills aquifer system. Yields from these aquifers are not expected to exceed 50 gallons per minute. The water generally is soft and a sodium bicarbonate type. Aquifers in the glacial drift--Lake Nettie system, Martin system, Butte, Painted Woods Creek, and North Burleigh--Underlie about 300 square miles in Sheridan County. Well yields of more than 500 gallons per minute may be generally is hard. (USGS)

1980 Geologic map of North Dakota
Clayton, Lee
U.S. Geological Survey Map G77220

GEOLOGY OF MOUNTRAIL COUNTY, NORTH DAKOTA
CLAYTON, L.
GEOLOGICAL SURVEY, GRAND FORKS, N. DAK.
NORTH DAKOTA GEOLOGICAL SURVEY BULLETIN 55 - PART IV, AND NORTH DAKOTA STATE WATER COMMISSION COUNTY GROUNDWATER STUDY 14 - PART IV, 1972. 70 P, 9 FIG, 2 MAP, 1 TAB, 27 REF.,
Journal Announcement: SWRA0704

THIS IS VOLUME IV OF A FOUR-VOLUME REPORT ON THE GEOLOGY AND GROUNDWATER RESOURCES OF BURKE AND MOUNTRAIL COUNTIES, N. DAK. THIS VOLUME IS DIVIDED INTO TWO SECTIONS. SECTION A IS A DESCRIPTION OF THE TOPOGRAPHY, THE ROCK AND SEDIMENT, AND THE GENERAL HYDROLOGY OF MOUNTRAIL COUNTY. IN ADDITION, SECTION A CONTAINS A BRIEF SUMMARY OF THE AGE AND ORIGIN OF THE TOPOGRAPHY, ROCK, AND SEDIMENT OF THE COUNTY. SECTION A IS WRITTEN FOR THOSE (ESPECIALLY NONGEOLOGISTS) WHO ARE INTERESTED IN THE PHYSICAL NATURE OF THE NEAR-SURFACE EARTH MATERIALS UNDERLYING THE COUNTY. SECTION B IS A MORE DETAILED DISCUSSION OF THE PROBLEMS INVOLVED IN DETERMINING THE AGE AND ORIGIN OF THE GEOLOGIC MATERIALS AND LANDFORMS IN MOUNTRAIL COUNTY. THIS SECTION IS WRITTEN FOR THOSE (ESPECIALLY GEOLOGISTS) WHO ARE INTERESTED IN THE GEOLOGIC PROCESSES AND SEQUENCE OF EVENTS DURING LATE CENOZOIC TIME IN THIS AREA. CONTRACTORS AND CIVIL

ENGINEERS INTERESTED IN THE GROSS CHARACTERISTICS OF FOUNDATION MATERIALS AT POTENTIAL CONSTRUCTION SITES CAN DETERMINE THE KINDS OF MATERIALS TO BE EXPECTED FROM A MAP INCLUDED. GENERAL INFORMATION CONCERNING GROUNDWATER POLLUTION ALSO IS PRESENTED. (WOODARD-USGS)

Hydrologic Characteristics and Possible Effects of Surface Mining in the Northwestern Part of West Branch Antelope Creek Basin, Mercer County, North Dakota

Crawley, M. E.; Emerson, D. G.

Geological Survey, Bismarck, ND. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-218371, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-79, December 1981. 73 p, 25 Fig, 11 Tab, 46 Ref.,

Journal Announcement: SWRA1605

Lignite beds and abundant discontinuous sandstone beds of the Paleocene Sentinel Butte Member of the Fort Union Formation and sand and gravel beds in the Quarternary glaciofluvial deposits (Antelope Creek aquifer) are the most important aquifers for domestic and livestock water supplies in the West Branch Antelope Creek basin. In the Beulah-Zap lignite, ground water moves from highland area in the west toward the Antelope Creek aquifer. Water levels in the basal Sentinel Butte sandstone appear to be controlled by the level of Lake Sakakawea. In the glaciofluvial deposits of the Antelope Creek aquifer water moves from a ground-water divide northwestward to Lake Sakakawea and southeastward toward the Knife River. Large water-level declines in wells completed in the lignite and shallower aquifers could be expected with mining. The effects probably would be limited to within 1 to 2 miles of an active mine. Surface-runoff duration could be altered by increased infiltration and retention in the reclaimed are and possible temporal extension of base flow could occur. Shallow ground water beneath mine sites would be expected to increase in dissolved solids and locally to contain large sodium and sulfate concentrations. In some locations movement of poor quality water toward the Antelope Creek aquifer would be expected. (USGS)

Ground-Water Resources of Adams and Bowman Counties, North Dakota

Croft, M. G.

Geological Survey, Bismark, ND. Water Resources Div.

North Dakota County Ground-Water Studies 22--Part III, and North Dakota Geological Survey Bulletin 65--Part III, 1978. 54 p, 18 fig, 4 plates, 7 tab, 51 ref.,

Journal Announcement: SWRA1124

The most important aquifer in Adams and Bowman Counties, N.Dak., is in the Fox Hills Formation and the basal part of the Hell Creek Formation. The aquifer system, which ranges in thickness from 340 to 520 feet, crops out in western Bowman

County and is as much as 940 feet below land surface in Adams County. The beds consist of fine- to medium-grained sandstone interbedded with siltstone and claystone. The transmissivity ranges from 110 feet squared per day in western Bowman County to 540 feet squared per day in eastern Adams County. Bowman, Hettinger, Reeder, and Scranton pump about 570 acre-feet of water annually from the aquifer system. Water from the aquifer system is generally clear and lower in dissolved solids and sulfate than water in the overlying aquifer systems. Dissolved solids in water samples analyzed ranged from 504 to 1,680 milligrams per liter and averaged 1,050 milligrams per liter. (Woodard-USGS)

GROUND-WATER RESOURCES OF MERCER AND OLIVER COUNTIES, NORTH DAKOTA

CROFT, M. G.

GEOLOGICAL SURVEY, BISMARCK, N. DAK.

NORTH DAKOTA GEOLOGICAL SURVEY BULLETIN 56, PART III, AND NORTH DAKOTA WATER COMMISSION COUNTY GROUND WATER STUDIES 15, PART III, 1973. 81 P, 37 FIG, 2 PLATE, 3 TAB, 38 REF.,

Journal Announcement: SWRA0610

IN MERCER AND OLIVER COUNTIES, NORTH DAKOTA, ARTESIAN AQUIFERS CONSISTING OF FINE- TO MEDIUM-GRAINED SANDSTONE OCCUR IN THE FOX HILLS AND HELL CREEK FORMATIONS OF LATE CRETACEOUS AGE AND THE TONGUE RIVER FORMATION OF TERTIARY AGE. THE WATER IS SUITABLE FOR LIVESTOCK, DOMESTIC, AND SOME INDUSTRIAL USES. THE TOTAL WITHDRAWAL FROM THE ARTESIAN AQUIFERS IS ABOUT 1 MILLION GALLONS PER DAY. GLACIAL AND ALLUVIAL DEPOSITS OF SAND AND GRAVEL FORM POTENTIALLY PRODUCTIVE AQUIFERS BENEATH THE VALLEYS OF GOODMAN, ANTELOPE, SQUARE BUTTE, AND ELM CREEKS AND THE KNIFE AND MISSOURI RIVERS. THE AQUIFERS, WHICH ARE RELATIVELY UNDEVELOPED, ARE 1 TO 5 MILES IN WIDTH, HAVE A MAXIMUM THICKNESS OF ABOUT 250 FEET, AND CONTAIN ABOUT 2,640,000 ACRE-FEET OF GROUNDWATER. THE KNIFE RIVER AQUIFER NEAR STANTON HAS A TRANSMISSIVITY OF 176,000 GPD PER FOOT AND A STORAGE COEFFICIENT OF 0.0003. THE MISSOURI RIVER AQUIFER NEAR HENSLER HAS A TRANSMISSIVITY OF 107,000 TO 121,000 GPD PER FOOT AND A STORAGE COEFFICIENT OF 0.02. APPPOXIMATELY 137,000 ACRE-FEET OF WATER WAS USED IN MERCER AND OLIVER COUNTIES IN 1968. MOST OF THIS WATER WAS TAKEN FROM THE MISSOURI RIVER FOR COOLING PURPOSES IN ELECTRIC-GENERATING PLANTS AND FOR IRRIGATION. ABOUT 2,270 ACRE-FEET WAS OBTAINED FROM GROUNDWATER SOURCES FOR INDUSTRIAL, LIVESTOCK, AND DOMESTIC USE. (WOODARD-USGS)

GROUNDWATER BASIC DATA, PART 2 OF GEOLOGY AND GROUNDWATER RESOURCES OF MERCER AND OLIVER COUNTIES, NORTH DAKOTA

CROFT, M. G.

GEOLOGICAL SURVEY, BISMARCK, N. DAK. COMMISSION GROUNDWATER STUDIES 15, 1970. 268 P, 2 FIG, 1 PLATE, 6 TAB, 11 REF.,

Journal Announcement: SWRA0322

DATA WERE COLLECTED TO BE USED TO: (1) DETERMINE THE

LOCATION, EXTENT, AND NATURE OF THE MAJOR AQUIFERS OF MERCER AND OLIVER COUNTIES, NORTH DAKOTA; (2) EVALUATE THE OCCURRENCE AND MOVEMENT OF GROUNDWATER, INCLUDING THE SOURCES OF RECHARGE AND DISCHARGE; (3) ESTIMATE THE QUANTITIES OF WATER STORED IN THE AQUIFERS; (4) ESTIMATE THE POTENTIAL YIELDS TO WELLS TAPPING TO MAJOR AQUIFERS; AND (5) DETERMINE THE CHEMICAL QUALITY OF THE GROUNDWATER. THE INFORMATION IN THIS REPORT WAS COLLECTED CHIEFLY BETWEEN 1966 AND 1969, AND CONSISTS OF THE FOLLOWING: (1) DATA ON ABOUT 1,300 WELLS AND TEST HOLES; (2) DATA ON 9 SPRINGS; (3) WATER-LEVEL MEASUREMENTS IN 29 OBSERVATION WELLS; (4) LOGS OF 299 TEST HOLES AND SELECTED WELLS; (5) CHEMICAL ANALYSES OF 160 WATER SAMPLES, AND (6) 25 PARTICLE-SIZE DISTRIBUTION CURVES. (KNAPP-USGS)

MAGNITUDE AND FREQUENCY OF FLOODS IN SMALL DRAINAGE BASINS IN NORTH DAKOTA
CROSBY, O. A.
GEOLOGICAL SURVEY, BISMARCK, N. DAK.
AVAILABLE FROM THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA 22161 AS PB-248 480, $4.00 IN PAPER COPY, $2.25 IN MICROFICHE. WATER-RESOURCES INVESTIGATIONS 19-27, MAY 1975. 24 P, 2 PLATES, 7 FIG, 2 TAB, 17 REF.,
Journal Announcement: SWRA0909

METHODS ARE PRESENTED FOR ESTIMATING FLOOD-PEAK DISCHARGES AT 2- TO 50-YEAR RECURRENCE INTERVALS ON NORTH DAKOTA STREAMS DRAINING LESS THAN 100 SQUARE MILES (259 SQUARE KILOMETRES). FOR GAGED SITES, FREQUENCY ESTIMATES ARE PROVIDED DIRECTLY. FOR UNGAGED SITES, THE METHOD RELATES DRAINAGE AREA AND(OR) SOIL-INFILTRATION INDEX TO PEAK DISCHARGES. THE EQUATIONS PRESENTED ARE FOR SITES ON STREAMS WITH NATURAL FLOW AND ARE NOT APPLICABLE TO URBAN AREAS OR BASINS AFFECTED BY MAN-MADE REGULATION. INFORMATION IS ALSO PROVIDED ON THE MAXIMUM FLOOD MAGNITUDE EXPERIENCED. (WOODARD-USGS)

Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana
Emerson, D. G.
Geological Survey, Bismarck, ND. Water Resources Div.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $4.25, Microfiche $3.50. Geological Survey Open-File Report 81-678, June, 1981. 28 p, 6 Fig, 7 Tab, 11 Ref.,
Journal Announcement: SWRA1509

The purpose of the investigation is to provide a means to assess the impacts on surface-water hydrology due to changes in land use resulting from surface mining of coal in the Fort Union Coal Region, North Dakota and Montana. The objectives of the study are to: (1) Determine premining hydrologic conditions in small representative drainage basins and provide historical data with which to compare the magnitude of changes resulting from mining, and (2) develop the capability of making reasonably accurate projections of hydrologic effects resulting from the various land-use changes caused by surface mining. Data collection has been underway since October 1976 for the West Branch Antelope Creek study area in western North Dakota and since March 1978 for the Hay Creek study area in eastern Montana. Data collected during the premining period are being analyzed using statistical methods for the evaluation of the premining conditions. A digitial model with the capability of making hydrologic projections is being developed. Most of the model components have been tested during 1979 and 1980. (USGS)

Hydrologic Analysis of High Flow from Snowmelt on Small Basins in the Fort Union Coal Region.
Emerson, Douglas G.
U.S. Geological Survey

Data from the Surface-Water Hydrologic Investigations of the Hay Creek Study Area, Montana, and the West Branch Antelope Creek Study area, North Dakota, October 1976 Through April 1982
Emerson, Douglas G., Norbeck, Steven W., and Boespflug, Kelvin L.
U.S. Geological Survey Open-File Report 83-136
Data are provided for the Hay Creek study area near Wibaux, Mont., and the West Branch Antelope Creek study area near Beulah, N. Dak. The report contains data on the following: Air temperature, relative humidity, wind direction, wind run, solar radiation, precipitation, soil temperature, snowpack temperature, snowpack density and water content, streamflow, water quality, soil moisture, land use, and basin characteristics. Detailed descriptions of the location of the data-collection sites, instrumentation, and methods used to collect data are included.

Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80
Haffield, N. D.
Geological Survey, Bismarck, ND. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-xxxxxx, Price codes: Axx in paper copy, A01 in microfiche. Geological Survey Open-File Report 81-1066, July 1981. 78 p, 1 Fig, 11 Ref. ,
Journal Announcement: SWRA1512
Statistics for the streamflow and water-quality data collected at 67 stations in western North Dakota from October 1977 through September 1980 are presented in a format that will make the data more useful to those who are making water-resources planning and development decisions. (USGS)

Hydrogeology and Geochemistry of the Wibaux-Beach Lignite Deposit Area, Eastern Montana and western North Dakota.
Horak, W. F.

U.S. Geological Survey

Hydrogeochemical Consequences of Strip Mining in the Fort Union Group of Southwestern North Dakota
Houghton, Robert L.
U.S. Geological Survey

An increase in lignite production from 0.1 to 3.0 million tons annually from a strip mine near Gascoyne in south-western North Dakota was accompanied by significant degradation in quality and quantity of shallow ground water. Near Gascoyne, the 30-foot Harmon lignite bed of the Bullion Creek Formation of the Paleocene Fort Union Group (designated Fort Union Formation by the U.S. Geological Survey) is an important source of domestic water. The lignite aquifer is recharged principally by precipitation and discharges mainly through its underclay to the underlying Slope-basal Bullion Creek sandstone aquifer and by lateral flow to local streams.

As recharge to both aquifers is dominated by locally infiltrating precipitation, the quality of shallow ground water is controlled mainly by processes in the unsaturated zone. Laboratory experiments, field observations, and geochemical modeling indicate ground-water quality is controlled largely by: dissolution of soil gases, oxidation of iron-sulfide minerals, dissolution of carbonate minerals, precipitation and dissolution of gypsum, cation exchange on clay minerals, cation exchange and adsorption on lignitic materials, and sulfate reduction. Isotopic data indicate organic compounds may control some redox processes.

Most of these chemical reactions occur naturally but are accelerated by mine disturbances. Resultant mine waters are enriched in sodium, sulfate, and bicarbonate, with as much as a fivefold increase in dissolved solids.

Oxidation of reactable iron sulfides to sulfate salts proceeds to completion during the overburden stripping process. Dissolution of sulfate salts is the principal source of solutes to mine waters. As natural waters infiltrating below the root zone already are saturated with gypsum, increased solute load in mine waters can occur only where sulfate solubilities are increased by complementary reactions, principally involving organic compounds. Where spoils materials are devoid of relict lignite and near-surface overburden is selectively replaced above the water table, water in the spoil piles is not significantly enrighed in solutes.

Dewatering of the lignite aquifer within the mine to facilitate stripping has produced large cones of depression centered on the mine in the lignite and sandstone aquifers. The cone of depression in the sandstone aquifer exceeds 30 feet in depth at its center and extends 2 miles beyond mine boundaries. Parts of the lignite aquifer destroyed by mining are re-established in rubble zones at the base of the spoils pile. As compaction of the spoils occurs, its hydraulic conductivity is decreased, limiting aquifer flow and retarding recharge. Long-term deterioration of shallow aquifers mined in recharge areas may be expected.

Composition of Atmospheric Deposition in Western North Dakota
Houghton, Robert L.
U.S. Geological Survey

Trace-Element Enrichments in Waters Associated with Strip Mining of Lignite in the Fort Union Group of Southwestern North Dakota
Houghton, Robert L.
U.S. Geological Survey

Weathering of outcropping lignite and strip mining in the Fort Union Group near Gascoyne in southwestern North Dakota have resulted in enrichment of several trace elements in local ground and surface waters. The 30-foot Harmon lignite bed of the Bullion Creek Formation of the Paleocene Fort Union Group (as used by the North Dakota Geological Survey) crops out along an east-trending bench in the Gascoyne area and dips north toward the center of the williston basin at 20-30 feet per mile. At the Gascoyne mine, weathered lignite (leonardite) along the outcrop and unoxidized lignite at depth are strip mined within an eight square mile area.

In the Gascoyne area, the shallow Harmon lignite provides water for local domestic and livestock use. The lignite aquifer is recharged by local precipitation and discharges principally through a basal claystone bed to an underlying sandstone aquifer and by lateral flow to intermittent streams within the mine area. As these streams are also used for livestock water, deterioration of water in the lignite aquifer could force ranchers to develop deeper, more expensive, water sources.

Along the lignite outcrop line, oxidation of the organic compounds releases complexed B, Be, and Se that are readily dissolved by infiltrating waters. Additionally, oxidation of Fe sulfide minerals makes a variety of chalcophile trace metals available for dissolution. Stripping the overburden during mining accelerates the oxidation of reactable Fe sulfides to completion in the poorly consolidated Fort Union strata, increasing the availability of trace metals like Cd, Cu, Fe, and Zn which occur as impurities in the Fe sulfides. Because infiltrating solutions are nearly saturated with carbonate, Fe is largely removed as siderite or in the phreatic zone as limonite. Other trace chalcophiles released during sulfide oxidation are precipitated as complex sulfate salts, including copiapite, melanterite, and jarosite. Concentrations of these metals in infiltrating waters are controlled by sulfate-salt solubilities. Where sulfate salts occur adjacent to relict lignite in the spoils, solubilities are greatly enhanced by preferential adsorption of Ca and Mg. Five-fold trace-metal enrichments are observed in parts of the lignite aquifer downgradient from active mine pits and in surface waters at base flow. Cadmium, Cu, Pb, and Se concentrations exceed recommended domestic water criteria in many parts of the lignite aquifer. Although concentrations of these trace elements currently do not exceed recommended levels for livestock use, expanded mining may alter this condition.

Weathering of Coal Scoria--A Source for Diagenetic Silica Cements?
Houghton, Robert L.
U.S. Geological Survey
Coal scoria, clastic sedimentary rocks baked by the natural, in-situ combustion of coal, has long been considered relatively inert in most low-temperature geochemical systems. However, chemical weathering of scoria may be important in the early diagenesis of its surrounding strata.

During underground burning of coal, blocks of sediment overburden may fall into the resultant coal furnace and fuse to a glasslike slag. Thus, concentrations of slag usually underlie major scoria zones. Like all glass, this slag is geologically unstable and will hydrate and release silicic acid to the ground-water system, making silica available for other diagenetic processes.

Scoria slag in the Paleocene Fort Union Formation near Gascoyne, North Dakota, is extensively hydrated and associated with minor secondary zeolite. Two such scoria zones are overlain by siliceous sedimentary horizons. One silica-cemented horizon has been described as a silcrete and overlies deeply weathered strata. The second siliceous horizon is comprised of semicontinuous silica-cemented concretions which apparently formed at depth, perhaps delineating a paleo-water-table position. The similarity of trace-element ratios in slag and associated silica cement indicates that hydration of fused scoria is the primary source of siliceous fluids responsible for diogenetic silica cementation of overlying Fort Union sediments. Similar silica cementation is absent in the underlying sediments and at the same stratigraphic level distant from scoria zones.

GROUND-WATER BASIC DATA FOR DUNN COUNTY, NORTH DAKOTA
KLAUSING, R. L.
GEOLOGICAL SURVEY, BISMARCK, N. DAK.
NORTH DAKOTA COUNTY GROUND-WATER STUDIES 25--PART II, AND NORTH DAKOTA GEOLOGICAL SURVEY BULLETIN 68--PART II, BISMARCK, N. D. 1976. 501 P, 3 FIG, 1 PLATE, 10 TAB, 20 REF, 2 APPEND.,
Journal Announcement: SWRA0924 COOPERATIVELY BY THE U.S. GEOLOGICAL SURVEY, NORTH DAKOTA STATE WATER MANAGEMENT DISTRICT. THE RESULTS OF THE INVESTIGATION WILL BE PUBLISHED IN THREE SEPARATE PARTS. PART (1) IS AN INTERPRETIVE REPORT DESCRIBING THE GEOLOGY OF THE STUDY AREA; PART (2) IS A COMPILATION OF THE GROUND-WATER BASIC DATA; AND PART (3) IS AN INTERPRETIVE REPORT DESCRIBING THE GROUND WATER RESOURCES. PART (2) (THIS REPORT) CONTAINS BASIC DATA FOR 1,216 WELLS AND TEST HOLES AND 134 SPRINGS. IT INCLUDES 632 LOGS OF TEST HOLES AND WELLS, 408 CHEMICAL ANALYSES OF WATER SAMPLES, AND WATER-LEVEL MEASUREMENTS

IN 140 OBSERVATION WELLS. THE GEOLOGIC FORMATIONS PENETRATED BY DRILLING ARE UPPER CRETACEOUS, TERTIARY, AND QUATERNARY IN AGE. (WOODARD-USGS)

Ground-Water Resources of Dunn County, North Dakota
Klausing, R. L.
Geological Survey, Bismarck, ND. Water Resources Div.
North Dakota County Ground-Water Studies 25--Part III, and North Dakota Geological Survey Bulletin 68--Part III, 1919. 48 p, 15 fig, 4 plates, 3 tab, 43 ref.,
Journal Announcement: SWRA1222

Ground water in Dunn County, N. Dak., is obtainable from aquifers in the preglacial rocks and from aquifers in the glacial drift. The aquifers in the preglacial rocks have a greater areal distribution than those in the glacial drift, but those in the drift provide higher yields to individual wells. Aquifers in the preglacial rocks occur in the Fox Hills and Hell Creek Formations of Cretaceous age and in the undifferentiated Cannonball-Ludlow, Tongue River, and Sentinel Butte Formations of Tertiary age. These aquifers will yield from 1 to 200 gallons per minute. The water from these aquifers is predominantly soft and is a sodium bicarbonate type. The Killdeer, Knife River, and Goodman Creek aquifers in the glacial drift are capable of yielding water at rates of as much as 1,000 gallons per minute. The Horse Nose Butte aquifer will yield water at rates of as much as 500 gallons per minute. Water from these aquifers is hard to very hard and is predominantly a sodium bicarbonate type. (Woodard-USGS)

GROUND-WATER RESOURCES OF MCLEAN COUNTY, NORTH DAKOTA
KLAUSING, R. L.
GEOLOGICAL SURVEY, BISMARCK, N. DAK.
NORTH DAKOTA GEOLOGICAL SURVEY BULLETIN 60, PART III, AND NORTH DAKOTA STATE WATER COMMISSION COUNTY GROUND-WATER STUDIES 19, PART III, 1974. 73 P, 24 FIG, 3 PLATE, 7 TAB, 45 REF, APPEND.,
Journal Announcement: SWRA0714

GROUNDWATER IN MCLEAN COUNTY, NORTH DAKOTA, IS OBTAINABLE FROM AQUIFERS COMPOSED OF SAND AND GRAVEL IN THE GLACIAL DEPOSITS AND SANDSTONE AND LIGNITE IN THE PREGLACIAL ROCKS. THE AQUIFERS WITH GREATEST POTENTIAL FOR DEVELOPMENT ARE THOSE IN THE GLACIAL DEPOSITS. MOST ARE ASSOCIATED WITH BURIED VALLEYS AND MELT-WATER CHANNELS. A LARGE INTERCONNECTED SYSTEM OF AQUIFERS IS ASSOCIATED WITH BURIED VALLEYS IN EAST-CENTRAL MCLEAN COUNTY. THE AQUIFERS CONTAIN ABOUT 940,000 ACRE-FEET OF GROUNDWATER IN AVAILABLE STORAGE. WELL YIELDS OF AS MUCH AS 1,500 GALLONS PER MINUTE ARE POSSIBLE FROM THE LAKE NETTIE AQUIFER. OTHER GLACIAL AQUIFERS HAVE WELL YIELDS OF AS MUCH AS 1,500 GPM. WELL YIELDS OF AS MUCH AS 1,000 GPM SHOULD BE OBTAINABLE MISSOURI RIVER IN WESTERN MCLEAN COUNTY. WATER FROM

THE AQUIFERS IN THE GLACIAL DEPOSITS IS PREDOMINANTLY A SODIUM BICARBONATE OR CALCIUM BICARBONATE TYPE AND IS USUALLY HARD TO VERY HARD. WELLS TAPPING THE FORT UNION GROUP OF PALEOCENE AGE GENERALLY YIELD FROM 5 TO 75 GPM; HOWEVER, IN PLACES YIELDS AS GREAT AS 200 GPM MAY BE POSSIBLE. THE WATER IS PREDOMINANTLY A SODIUM BICARBONATE TYPE. WELLS TAPPING THE HELL CREEK AND FOX HILLS FORMATIONS YIELD FROM 10 TO 50 GPM. THE WATER IS PREDOMINANTLY A SODIUM BICARBONATE TYPE. (KNAPP-USGS)

GROUND-WATER RESOURCES OF MCLEAN COUNTY, WEST-CENTRAL NORTH DAKOTA

KLAUSING, R. L.

GEOLOGICAL SURVEY, WASHINGTON, D.C.

AVAILABLE FROM USGS, WASHINGTON, DC 20242-PRICE $0.75. GEOLOGICAL SURVEY HYDROLOGIC INVESTIGATIONS ATLAS HA-475, 1972. 1 SHEET, 1 FIG, 1 MAP, 1 TAB, 6 REF.,

Journal Announcement: SWRA0523

THIS ONE-SHEET HYDROLOGIC ATLAS DESCRIBES THE OCCURRENCE AND MOVEMENT OF GROUNDWATER IN MCLEAN COUNTY, N. DAK., INCLUDING THE SOURCES AND AREAS OF RECHARGE AND DISCHARGE, THE POTENTIAL YIELDS OF WELLS TAPPING THE MAJOR AQUIFERS, AND THE CHEMICAL QUALITY OF THE GROUNDWATER. IMPORTANT AQUIFERS OCCUR BOTH IN THE GLACIAL DRIFT AND IN THE UNDERLYING BEDROCK FORMATIONS. THE MAJOR GLACIAL-DRIFT AQUIFERS GENERALLY WILL YIELD MORE THAN 50 GPM TO INDIVIDUAL WELLS AND IN PLACES WILL YIELD MORE THAN 1,000 GPM. THREE BEDROCK UNITS--THE FORT UNION FORMATION, HELL CREEK FORMATION, AND FOX HILLS SANDSTONE--SUPPLY WATER TO WELLS IN MCLEAN COUNTY. THE MOST PRODUCTIVE BEDROCK AQUIFERS CONSIST OF SANDSTONE AND LIGNITE BEDS. WELLS FROM THE BEDROCK AQUIFERS IS PREDOMINANTLY SOFT AND IS A SODIUM BICARBONATE TYPE. WATER FROM THE GLACIAL-DRIFT AQUIFERS GENERALLY IS HARDER BUT LESS SALINE AND OF BETTER QUALITY THAN WATER FROM THE BEDROCK AQUIFERS. (WOODARD-USGS)

GROUNDWATER RESOURCES OF RENVILLE AND WARD COUNTIES

PETTYJOHN, W. A.; HUTCHINSON, R. D.

GEOLOGICAL SURVEY, BISMARCK, N. DAK.

NORTH DAKOTA GEOLOGICAL SURVEY BULLETIN 50-PART III, AND NORTH DAKOTA WATER COMMISSION COUNTY GROUND-WATER STUDIES 11-PART III, 1971. 100 P, 31 FIG, 2 PLATE, 8 TAB, 48 REF.,

Journal Announcement: SWRA0503

TWO TYPES OF AQUIFERS OCCUR IN RENVILLE AND WARD COUNTIES, NORTH DAKOTA--THOSE IN THE SEMICONSOLIDATED AND CONSOLIDATED BEDROCK FORMATIONS AND THOSE IN THE UNCONSOLIDATED GLACIAL DEPOSITS. THE FORT UNION GROUP CONTAINS THE MOST PRODUCTIVE BEDROCK AQUIFERS. GENERALLY WATER FROM THE FORT UNION IS A SODIUM BICARBONATE TYPE OR A SODIUM CHLORIDE TYPE. THE WATER IS UNSUITABLE FOR IRRIGATION AND IN MANY PLACES IS UNDESIRABLE FOR DOMESTIC USE. DEPOSITS OF QUATERNARY AGE COMPRISE THE MAJOR AQUIFERS WITH YIELDS OF MORE

THAN 500 GPM OF GOOD QUALITY WATER. THE MOST PRODUCTIVE AQUIFERS ARE IN THE VALLEYS OF THE SOURIS AND DES LACS RIVERS. WELL YIELDS OF MORE THAN 500 GPM ARE AVAILABLE FROM THE KENMARE AQUIFER AND LOCALLY FROM AQUIFERS IN THE SOURIS RIVER VALLEY BETWEEN MINOT AND LOGAN. NORTHWEST OF MINOT AND BETWEEN LOGAN AND SAWYER, YIELDS OF 50 TO 500 GPM CAN BE EXPECTED. MUCH OF THE WATER IN THE VALLEY AQUIFERS IS SUITABLE FOR DOMESTIC, MUNICIPAL, AND INDUSTRIAL USES. SUBSTANTIAL QUANTITIES OF GROUNDWATER ARE STORED IN SURFICIAL SAND AND GRAVEL DEPOSITS IN ICE-MARGINAL CHANNELS. IN MOST PLACES, THE WATER HAD A SPECIFIC CONDUCTANCE THAT IS LESS THAN 1,000 MICROMHOS. (WOODARD-USGS)

GEOLOGY AND GROUND WATER RESOURCES OF RENVILLE AND WARD COUNTIES, PART 2--GROUND WATER BASIC DATA
PETTYJOHN, WAYNE A.
US GEOLOGICAL SURVEY.
N DAK GEOL SURV BULL 50, 302 P, 1968. 2 FIG, 1 PLATE, 6 TAB.,
Journal Announcement: SWRA6801
THIS BASIC-DATA VOLUME IS PART 2 OF A SERIES. PART 1 DESCRIBES GEOLOGY AND PART 3 DESCRIBES THE GROUNDWATER RESOURCES OF THE 2 COUNTIES LOCATED IN NORTH-CENTRAL NORTH DAKOTA. THE BASIC DATA ARE USEFUL FOR PREDICTING GEOLOGIC AND GROUNDWATER CONDITIONS AT A PROPOSED WELL SITE. TABLES LIST (1) DESCRIPTIVE DATA FOR 1,373 WELLS AND TEST HOLES, (2) WATER-LEVEL MEASUREMENTS IN 81 WELLS, (3) LOGS OF 242 TEST HOLES AND WELLS, AND (4) CHEMICAL ANALYSES OF 416 WATER SAMPLES. AQUIFERS IN THE COUNTIES ARE CONSOLIDATED BEDROCK UNITS AND GLACIAL DEPOSITS.

Plan of study of the hydrology of the Madison Limestone and associated rocks in parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming.
Open-File Report 75-631, December 1975, 35 p. 5 fig. 2 tab, 43 ref. 77-03332. (duplicated see Wyoming).

GROUND-WATER BASIC DATA FOR GRANT AND SIOUX COUNTIES, NORTH DAKOTA
RANDICH, P. G.
GEOLOGICAL SURVEY, BISMARCK, N. DAK.
NORTH DAKOTA, GEOLOGICAL SURVEY, BISMARCK, COUNTY GROUND-WATER STUDIES 24--PART II, AND NORTH DAKOTA GEOLOGICAL SURVEY BULLETIN 67--PART II, 1975. 303 P, 2 FIG, 1 PLATE, 8 TAB, 23 REF, APPEND.,
Journal Announcement: SWRA0902 CHIEFLY BETWEEN 1971 AND 1974. THE DATA INCLUDE: (1) GEOLOGIC AND MEASUREMENTS IN 77 OBSERVATION WELLS; (3) LITHOLOGIC AND GEOPHYSICAL LOGS OF 257 TEST HOLES AND WELLS; (4) 135 CHEMICAL ANALYSES OF GROUNDWATER; (5) 15 CHEMICAL ANALYSES OF WATER FROM STREAMS DURING LOW FLOW;

(6) 13 CHEMICAL ANALYSES OF MINOR ELEMENTS IN WATER FROM WELLS; (7) 30 PARTICLE-SIZE DISTRIBUTION GRAPHS; AND (8) 30 ANALYSES OF CORE SAMPLES FOR HYDRAULIC PARAMETERS AND HEAVY MINERAL CONTENT. (WOODARD-USGS)

Ground-Water Resources of Grant and Sioux Counties, North Dakota
Randich, P. G.
Geological Survey, Bismarck, ND. Water Resources Div.
North Dakota County Ground-Water Studies 24--Part III, and North Dakota Geological Survey Bulletin 67--Part III, 1979. 49 p, 19 Fig, 5 Plates, 3 Tab, 52 Ref.,
Journal Announcement: SWRA1311

Ground water in Grant and Sioux Counties is obtainable from aquifers of Late Cretaceous, Tertiary, Pleistocene, and Holocene age. The major bedrock aquifers in the counties are the Fox Hills and Hell Creek aquifers of Late Cretaceous age and the Cannonball and Ludlow, undifferentiated, and Tongue River aquifers of Tertiary age. Potential yields to individual wells range from about 5 to 150 gallons per minute. The water generally is soft and high in dissolved solids. Aquifers of Pleistocene age--the Shields, Elm Creek, St. James, Beaver Creek, and Battle Creek aquifers--underlie about 48 square miles in Grand and Sioux Counties. Well yields of as much as 1,000 gallons per minute are obtainable in a few places along the central axes of these aquifers. The major dissolved constituents in water from these aquifers are calcium, magnesium, sodium, bicarbonate, and sulfate. Aquifers of Holocene age are located in the alluvial deposits in the Cannonball River, Heart River, and Cedar Creek valleys. Potential well yields generally are less than 50 gallons per minute. (Kosco-USGS)

Groundwater Data for McHenry County, North Dakota
Randich, P. G.
Geological Survey, Bismarck, ND. Water Resources Div.
North Dakota County Groundwater Studies 33--Part II, and North Dakota Geological Survey Bulletin 74--Part II, 1981. 446 p, 2 Fig, 1 Plate, 8 Tab, 26 Ref.,
Journal Announcement: SWRA1420

The purpose of the investigation in McHenry County, N. Dak., was to provide detailed geologic and hydrologic information needed for the orderly development of water supplies for municipal, domestic, livestock, irrigation, industrial, and similar uses. Specifically, the objectives were to: (1) determine the location, extent, and nature of the major aquifers; (2) evaluate the occurrence and movement of groundwater, including the sources of recharge and discharge; (3) estimate the quantities of water stored in the glacial aquifers; (4) estimate the potential yields of wells tapping the major aquifers; (5) evaluate the chemical quality of the groundwater; and (6) estimate the water use. The data in this report were collected chiefly between 1974 and 1978. The points of collection are shown. The data consist of the following: (1) Geologic and hydrologic records of wells and test holes; (2) water-level measurements in observation wells; (3) lithologic and geophysical logs of test holes and wells; (4) chemical analyses of groundwater; (5) chemical analyses of water from streams during low flow; (6) particle-size distribution graphs; (7) analyses of core samples for heavy-mineral content; and (8) hydraulic parameters and statistical characteristics of grain-size analyses. (USGS)

Summary Appraisals of the Nation's Ground-Water Resources--Souris-Red-Rainy Region
Reeder, H. O.
Geological Survey, St. Paul, MN. Water Resources Div.
Available from Supt. of Documents, GPO, Washington, DC 20402; price, $1.40. Professional Paper 813-K, 1978. 25 p, 14 fig, 7 tab, 36 ref.,
Journal Announcement: SWRA1122

A broad-perspective analysis of the ground-water resources and present and possible future water development and management in the Souris-Red-Rainy Region is presented. The region includes the basins of the Souris River within Montana and North Dakota; the Red River of the North in South Dakota, North Dakota, and Minnesota; and the Rainy River within Minnesota. The region includes 59,645 square miles, mostly in North Dakota and Minnesota. This report is one of a U.S. Geological Survey series that summarizes information on the Nation's ground water for the guidance of planners. New data were not collected for this appraisal, but information from many sources has been utilized. In addition to summarizing the knowledge of ground-water resources of the region, the report points out deficiencies in knowledge. The primary objective of evaluating information deficiencies is to direct attention to types of studies and information that will lead to fuller understanding and description of ground-water reservoirs for better evaluation, planning, and management of the region's management of all water resources, ground water can assume greater significance in the region's development. (Woodard-USGS)

The Geochemistry of the Fox Hills-Basal Hell Creek Aquifer in Southwestern North Dakota and Northwestern South Dakota
Thorstenson, D. C.; Fisher, D. W.; Croft, M. G.
Geological Survey, Reston, VA. Water Resources Div.
Water Resources Research, Vol 15, No 6, p 1479-1498,

December 1979. 9 Fig, 5 Tab, 68 Ref.,
Journal Announcement: SWRA1318

The Upper Cretaceous Fox Hills Formation and the basal part of the overlying Hell Creek Formation constitute an important aquifer in the Fort Union coal region. Throughout most of southwestern North Dakota and northwestern South Dakota the aquifer is at depths ranging from 1,000 to 2,000 feet, except for exposures along the Cedar Creek anticline. Water flows in the aquifer from southwest to northeast, with flow rates of a few feet per year. The recharge and discharge areas of the aquifer are separated by a north-south trending transition zone in which significant changes in water chemistry occur. Computer modeling and carbon isotope data suggest the following reactions in the recharge area. Carbon dioxide derived from lignitic carbon reacts to dissolve carbonate minerals, with cations then being exchanged for sodium on clay minerals. The high pH in the aquifer is the result of buffering by carbonate-ion exchange equilibria. These changes can be accounted for by reactions in the aquifer: (1) Sulfate is reduced by lignitic carbon with formation of pyrite; (2) Hydrogen-ion concentration is continuously buffered by the carbonate-ion exchange equilibria. Chemical and hydrologic data suggest that the increase in sodium chlorine results from upward movement of small volumes of water into the Fox Hills aquifer from the transition zone eastward. Redox reactions in the aquifer are closely analogous to those observed in pore waters of reducing marine sediments. Reactions approach, but not achieve, true thermodynamic equilibrium. Measurements of redox potential suggest a down-gradient decrease in redox potential. The measurements are not amenable to quantitative interpretation. (Kosco-USGS)

GEOLOGY AND GROUND-WATER RESOURCES OF HETTINGER AND STARK COUNTIES, NORTH DAKOTA
TRAPP, H. JR; CROFT, M. G.
GEOLOGICAL SURVEY, BISMARCK, N. DAK.
NORTH DAKOTA STATE WATER COMMISSION, BISMARCK, COUNTY GROUND-WATER STUDIES 16--PART I, 1975. 51 P, 14 FIG, 4 PLATES, 4 TAB, 52 REF.,
Journal Announcement: SWRA0915

THE SEDIMENTARY ROCKS OF PALEOZOIC, MESOZOIC, AND CENOZOIC AGE IN HETTINGER AND STARK COUNTIES, N. DAK., ON THE SOUTH-CENTRAL FLANK OF THE WILLISTON STRUCTURAL BASIN, ARE ABOUT 14,000 FEET THICK. THEY ARE GENTLY FOLDED INTO NORTH-PLUNGING ANTICLINES AND SYNCLINES. THE FOX HILLS AND BASAL HELL CREEK AQUIFER SYSTEM UNDERLIES THE ENTIRE AREA AT DEPTHS GREATER THAN 1,100 FEET. THE WATER IN THIS SYSTEM IS A SODIUM BICARBONATE TYPE WITH CREEK AND LOWER CANNONBALL-LUDLOW AQUIFER SYSTEM UNDERLIES ALL OF HETTINGER AND STARK COUNTIES. THE WATER CONTAINS A SODIUM BICARBONATE TYPE WITH A IN THE BASAL SANDSTONE MEMBER IS GENERALLY A SODIUM BICARBONATE TYPE WITH A SENTINEL BUTTE AQUIFER SYSTEM UNDERLIES MOST OF STARK

COUNTY. THE WATER IS GENERALLY OF A SODIUM SULFATE TYPE. DISSOLVED-SOLIDS CONCENTRATION OF THE WATER WAS OBTAINED FROM GROUNDWATER AND SURFACE-WATER SOURCES IN 1969. GROUNDWATER SOURCES FURNISHED ABOUT 40 PERCENT OF THE TOTAL WATER SUPPLY. (WOODARD-USGS)

GROUND WATER BASIC DATA, HETTINGER AND STARK COUNTIES, NORTH DAKOTA

TRAPP, HENRY JR

GEOLOGICAL SURVEY, BISMARCK, N. DAK. 1971. 455 P, 2 FIG, 1 PLATE, 7 TAB, 19 REF.,

Journal Announcement: SWRA0416

HYDROLOGIC INVESTIGATIONS WERE MADE IN HETTINGER AND STARK COUNTIES, N. DAK. TO DETERMINE THE QUANTITY AND QUALITY OF GROUNDWATER AVAILABLE FOR MUNICIPAL, DOMESTIC, LIVESTOCK, INDUSTRIAL, AND IRRIGATION USES. THE INFORMATION WAS COLLECTED BETWEEN 1966 AND 1969, AND CONSISTS OF THE FOLLOWING: (1) DATA ON 3,060 WELLS AND TEST HOLES; (2) DATA ON 91 SPRINGS; (3) WATER-LEVEL MEASUREMENTS IN 61 OBSERVATION WELLS; (4) LOGS OF 544 TEST HOLES AND WELLS; (5) CHEMICAL ANALYSES OF 261 WATER SAMPLES; (6) COLOR VALUES OF 331 WATER SAMPLES; AND (7) 23 PARTICLE-SIZE DISTRIBUTION CURVES. THE DATA ARE PRESENTED IN TABLES AND MAPS. (WOOD-USGS)

Stripping coal deposits of the Northern Great Plains, Montana, Wyoming, North Dakota, and South Dakota

U.S. Geological Survey, 1974

U.S. Geological Survey Miscellaneous Field-Studies Map MF-590

Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981

Geological Survey, Bismarck, ND. Water Resources Div.

Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $7.00, Microfiche $3.50. Geological Survey Open-File Report 81-923, July, 1981. 50 p, 4 Fig. (Compiled by Martin, C. R., and Albright, L. L.).,

Journal Announcement: SWRA1505

Water-resources studies and investigations in North Dakota made by the U.S. Geological Survey in cooperation with State and Federal agencies are summarized. The investigations include data-collection projects, county ground-water studies, regional water-resource studies, aquifer evaluations, energy-related water-resource studies, and special investigations. The special investigations include snow survey research, ground-water quality sampling technique research and hydrologic response changes on a major stream. (USGS)

Water Resources Data for North Dakota, published annually since 1975.
Geological Survey, Bismarck, ND. Water Resources Div.
Geological Survey Water-Data Report.
Water resources data for North Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in North Dakota. (USGS)

WATER RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN THE NORTHERN GREAT PLAINS COAL REGION OF WYOMING, MONTANA, AND NORTH DAKOTA, 1975
GEOLOGICAL SURVEY, DENVER, COLO. WATER RESOURCES DIV.
OPEN-FILE REPORT, MAY 1975. 110 P, 27 FIG, 27 REF.,
Journal Announcement: SWRA0824
THE GEOLOGICAL SURVEY'S WATER RESOURCES DIVISION HAS FOR MANY YEARS MAINTAINED A PROGRAM OF WATER-RESOURCES INVESTIGATIONS THAT INCLUDES THE COAL REGIONS OF WYOMING, MONTANA, AND NORTH DAKOTA. THE RECENT INTEREST IN COAL HAS ADDED NEW DIMENSIONS AND GREATER INTENSITY TO THE INVESTIGATIONS. THE WORK HAS EXPANDED TO INCLUDE MONITORING THE ENVIRONMENTAL EFFECTS OF COAL MINING AND PROCESSING AND TO DETERMINE THE AVAILABILITY OF ADDITIONAL WATER SUPPLIES FOR COAL-CONVERSION PLANTS AND RELATED DEMANDS. THIS REPORT DESCRIBES THE WATER-RESOURCES INVESTIGATION PROGRAM THAT IS CURRENTLY IN OPERATION. LOCATIONS OF GAGING STATIONS AND WATER-QUALITY MEASURING SITES, FREQUENCIES AND PARAMETERS, AND AREAS OF GROUNDWATER STUDIES ARE INCLUDED. BRIEF DESCRIPTIONS OF COAL-RELATED STUDIES BY INVESTIGATORS WHO ARE HEADQUARTERED OUTSIDE THE NORTHERN GREAT PLAINS COAL REGIONS ARE ALSO INCLUDED. SUCH STUDIES ARE RESEARCH IN TOPICS RELATED TO COAL EXTRACTION, WATER SUPPLY, AND POST-MINING RECLAMATION. (WOODARD-USGS)

WATER-RESOURCES INVESTIGATIONS IN THE FORT UNION COAL REGION, NORTH DAKOTA, 1975-76
GEOLOGICAL SURVEY, BISMARCK, N. DAK.
OPEN-FILE REPORT, JANUARY 1976. 43 P, 11 FIG.,
Journal Announcement: SWRA0910
OWING TO THE CURRENT EMPHASIS ON ENERGY DEVELOPMENT, A RATHER LARGE NUMBER OF GEOLOGIC AND HYDROLOGIC STUDIES EITHER ARE UNDERWAY OR ARE PROPOSED BY A NUMBER OF AGENCIES AND PRIVATE COMPANIES WORKING IN THE FORT UNION COAL REGION OF NORTH DAKOTA. THE PURPOSE OF THIS REPORT IS TO INFORM OTHER AGENCIES, PRIVATE COMPANIES, AND THE PUBLIC IN GENERAL OF THE ON-GOING AND COMPLETED WORK IN THE FORT UNION COAL REGION BY

THE WATER RESOURCES DIVISION OF THE U.S. GEOLOGICAL SURVEY. IT IS HOPED THAT KNOWLEDGE OF THESE ACTIVITIES WILL ENABLE OTHER INVESTIGATORS TO MORE EFFECTIVELY PLAN AND COORDINATE WORK OF A SIMILAR NATURE, AND, PERHAPS IN SOME INSTANCES, AVOID COSTLY AND NEEDLESS DUPLICATION. THE WORK DONE BY THE WATER RESOURCES DIVISION IN NORTH DAKOTA IS LISTED BY SEQUENTIAL PROJECT IDENTIFICATION NUMBER. SOME OF THE PROJECTS ARE PRIMARILY CONCERNED WITH DATA COLLECTION. OTHERS INVOLVE INTERPRETATION IN ADDITION TO DATA COLLECTION. THE RESULTS OF ALL PROJECTS ARE MADE AVAILABLE TO THE PUBLIC IN VARIOUS FORMS OF PUBLICATION. (WOODARD-USGS)

WATER-RESOURCES INVESTIGATIONS IN THE FORT UNION COAL REGION, NORTH DAKOTA, 1974-75
GEOLOGICAL SURVEY, BISMARCK, N.DAK.
OPEN-FILE REPORT, JANUARY 1975. 42 P, 10 FIG.,
Journal Announcement: SWRAU819

OWING TO THE CURRENT EMPHASIS ON ENERGY DEVELOPMENT, A RATHER LARGE NUMBER OF GEOLOGIC AND HYDROLOGIC STUDIES EITHER ARE UNDERWAY OR ARE PROPOSED BY A NUMBER OF AGENCIES AND PRIVATE COMPANIES WORKING IN THE FORT UNION COAL REGION OF NORTH DAKOTA. THE PURPOSE OF THIS REPORT IS TO INFORM OTHER AGENCIES, PRIVATE COMPANIES, AND THE PUBLIC IN GENERAL OF THE ON-GOING AND RECENTLY COMPLETED WORK BY THE WATER RESOURCES DIVISION OF THE U.S. GEOLOGICAL SURVEY IN THE FORT UNION COAL REGION. THE WORK DONE BY THE WATER RESOURCES DIVISION IN NORTH DAKOTA IS LISTED BY SEQUENTIAL PROJECT IDENTIFICATION NUMBER. SOME OF THE PROJECTS ARE PRIMARILY CONCERNED WITH DATA COLLECTION. OTHERS INVOLVE INTERPRETATION IN ADDITION TO DATA COLLECTION. A SUMMARY OF EACH PROJECT INCLUDES OBJECTIVES, COOPERATORS, AND AVAILABILITY OF THE REPORT. (WOODARD-USGS)

Ground-Water Data for selected coal areas in Western North Dakota
Wald, James D., and Norbeck, Steven W.
U.S. Geological Survey publication 222 pages, 13 Illus., 12 Tables, 25 Ref.

Ground-water data are provided for the Sand Creek-Hanks, New England-Mott, Dickinson, and Bowman-Gascoyne coal areas, western North Dakota.

The report contains the following: (1) Maps showing the location of wells, springs, and test holes; the location of test holes; where driller' logs are available; and the location of wells with chemical analysis; and (2) tables showing well, spring, and test hole records; logs; and chemical analyses of water.

Beulah Trench Study Site Coal Resource and Surface Mining Potential
Reclamation Evaluation in Mercer County, west-central North Dakota
BLM, Denver, Colorado
EMRIA Report No. 10-77

The 4.2 square mile Beulah Trench site in the Renners Cove Coalfield of the Williston Basin is characterized by rolling hills, bordered by flat melt-water channels on the east and south. Most of the site is drained by tributaries to ephemeral Antelope Creek. Annual precipitation is about 15 inches plus and evaporation is estimated to be 36 inches annually. The hills are underlain by bedrock. Till and alluvium cover the low lands. Nearly 110 million tons of coal are in beds more than 2.5 feet thick covered by less than 300 feet of overburden. Most of the coal is in the Beulah-Zap bed, part of the Sentinel Butte Member of the Paleocene Fort Union Formation. Small amounts of unconfined and semi-confined water occur in discontinuous sandstone layers above the coal. Small amounts are also found confined in the coal. Dissolved solids ranged from 1,010 to 2,150 milligrams per liter. Larger quantities of more highly mineralized water undoubtedly occur in deeper aquifers. Moderate to large quantities of water are available in the buried valleys on the east and south borders of the site. Mining would dewater the coal and aquifers above. Recharge, of poorer quality, to the buried valley aquifers would be hastened.

Falkirk Coal Lease Application, central North Dakota
BLM, Miles City, Montana
EA, 1976

This document analyzes the impacts of leasing 998.87 acres of Federal coal (19.2 million tons) in 8 scattered tracts (1/4 section or smaller) in McLean County, central North Dakota. Refusal to lease would leave the Federal coal isolated and economically unrecoverable. The tracts are in the prairie pothole region which is underlain by a veneer of glacial deposits. Relief is generally less than 25 feet. Precipitation is about 15 inches per year. Surface drainage is internal and most of the potholes contain brackish to briney water and many are ephemeral. Coal is in two seams totaling 11 feet thick, in the Sentinel Butte Formation at the top of the Upper Cretaceous Fort Union Group. Ground water occurs in the sandstones of the Fort Union Group below the coal, and in the underlying Hell Creek and Fox Hills Formations. Well yields range up to 75 gallons per minute, and dissolved solids range from 206 to 3,550 milligrams per liter. Wells in buried glacial channels in the vicinity yield as much as 200 gallons per minute of water containing from 277 to 1,360 milligrams per liter dissolved solids. Surface mining of these leases would have little influence on their hydrology.

Glenharold Mine Coal Lease, west-central North Dakota
BLM, Miles City, Montana
DEAR, 1976

This analysis examines and records possible impacts of BLM leasing 480 acres of Federal coal in three separate parcels in Mercer County, west-central North Dakota. No leasing would bypass the coal and would leave it uneconomical to mine in the future. About 9.5 million tons of coal occur in the Tongue River Formation under 140 feet or less of overburden. The lease areas, on a broad, gently rolling dissected plateau, drain to intermittent Alderin Creek. Much of the area is veneered with glacial till. Annual precipitation 10 miles south is 17.83 inches. Small quantities, less than 10 gallons per minute, of water occur in the coal, and as much as 150 gallons per minute have been obtained from basal Hell Creek-Fox Hills sandstones below the Tongue River. Water quality ranges between 1,000 and 2,000 milligrams per liter total dissolved solids. Mining of this coal would have little hydrologic impact in addition to that already taking place.

Glenharold Mine, west-central North Dakota
BLM, Miles City, Montana
DTEEA, 1979

This document assesses impacts of leasing 1,668.08 acres of Federal coal in seven tracts scattered among ongoing mining of private and existing Federal leased coal in Mercer and Oliver Counties, southwest-central North Dakota. Failure to lease would leave Federal coal in uneconomically minable units. The 25-square-mile area is mostly a broad, gently rolling plateau dissected by Missouri River Valley ravines on the northeast. A thin glacial till veneers most of the Tongue River Formation's glacial bedrock topography. The coal is in the Hazel bed (4 to 6 feet thick) and the lower Stanton bed (7 to 17 feet thick) of the Paleocene Tongue River Formation. Overburden, of clay and boulder till, siltstone, and claystone, averages 110 feet thick. Annual precipitation is 17.83 inches. Drainage is by ephemeral tributaries to the Knife River on the southwest and the Missouri River to the east. Runoff is about one inch per year. Ground water recharge is negligible. Mining would increase erosion and sedimentation until rehabilitation is complete, and would increase salinity of shallow ground water and dry up seeps.

Horse Nose Butte Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in the Dunn Center Lignite Field, west-central North Dakota
BLM, Denver, Colorado
EMRIA Report No. 9-77

The 4-square-mile Horse Nose Butte site overlies the central Williston Basin and is an area of rolling hills and poorly incised valleys. Maximum relief is 180 feet. Annual precipitation is 16 inches. Coal is in the Sentinel Butte Member of the Fort Union Formation. More than 96 million tons of lignite coal in four Dunne Center beds, 1.9 to 9.1 feet thick, are covered by less than 200 feet of sandstone, shale and till overburden. Annual runoff of 0.2 cubic feet per second is northwesterly into intermittent Slow Creek and tributaries. The site is a recharge area for the shallow ground water system and flow is down to deeper aquifers and to local surface drainage. Small quantities of water were found above, in and below the coal beds. Dissolved solids ranged from 245 to 3,500 miligrams per liter. Water for reclamation would come from the Little Missouri River, 14 miles north. Effects of mine dewatering will not extend beyond one mile of the mine. Deeper aquifers are isolated from mining effects by relatively impervious layers.

Velva Mine Coal Lease, north-central North Dakota
BLM, Miles City, Montana
FEAR, Undated (1976?)

This record analyzes the impacts of leasing 120 acres of Federal coal to avoid being bypassed by an ongoing mining operation. The site is 8 miles south of Velva and 20 miles southeast of Minot. It is on a gently sloping, 70-feet in one-half mile escarpment between the Missouri Coteau plateau and the drift prairie, at the head of intermittent Spring and Blacktail Creeks. Annual precipitation and lake evaporation are about 12 and 30 inches, respectively. About 1.5 million tons of recoverable coal remain beneath 65 acres in the less than 11-foot thick Coteau bed of the Paleocene Fort Union Group Tongue River Formation. The coal is under less than 30 feet of overburden consisting of shale and sandstone layers veneered by glacial drift and lake sediments. The bedrock layers are essentially flat-lying. Small quantities of water are perched in the coal on underlying clay, and contain 2,000 to 33,000 milligrams per liter of dissolved solids. Mining of this coal would have no significant impact on the hydrology of the area.

West-Central North Dakota Regional E. I. Study on Energy Development
BLM, Miles City, Montana
DEIS, 1978

This document evaluates impacts of 3 levels of energy development (surface coal mines and electric generating and coal gasification plants) in seven counties (Burleigh, Dunn, McLean, Mercer, Morton, Oliver and Stark). The area is bissected by the Missouri River Trench, the Missouri River, and its Sakakawea and Oahe Reservoirs. About a third of the area, which is northeast of the river, is underlain by a dissected bedrock surface veneered by glacial deposits, physiographically a part of the Missouri Coteau and Coteau Slope. Maximum local relief is about 25 feet. Most of the area southwest of the river is a gently, northeast sloping plateau containing rolling prairie, isolated buttes, mesas and badlands. Precipitation is 16 to 18 inches per year. The area northeast of the river is poorly drained and contains many small lakes, ponds and sloughs. Most of the area southwest of the river is drained into the Missouri River by the Knife and Hart Rivers and smaller tributaries. About 5 billion tons of strippable coal is in the Sentinel Butte and Tongue River Formations, which gently dip westward to the center of the Williston Basin. Moderate quantities of confined water, generally less than 50 gallons per minute, but exceptionally more than 100 gallons per minute have been obtained in the coal and sandstone layers above the underlying Pierre Shale. Water quality ranges from suitable to marginal for domestic and stock use. Below the top of the Pierre Shale, about 2,000 feet deep, water is too mineralized for domestic and stock use. Buried glacial meltwater channels have produced as much as 1,500 gallons per minute of usable quality water. More than adequate, as much as 300,000 acre-feet per year from Sakakawea Reservoir, good quality water is available from the Missouri River system. Level 1 development, two electric generating plants, two gasification plants and 4 strip mines, would require about 52,000 acre-feet of water per year, mostly for cooling, a significant part of which would be returned to the river system. Level 2 development which would add one electric generating plant, 5 new surface mines and expand one existing surface mine, would require an additional 10,000 acre-feet of water per year, mostly for cooling. Level 3 would increase coal extraction by 4.6 million tons per year and would require relatively insignificant additional water. Surface mining would reduce local tributary stream flows less than one percent, lower water levels in wells within one mile of the mines, destroy existing wells and springs, modify shallow aquifers, lose small surface water bodies, and degrade water quality. Plant operations would increase Missouri River temperature by an immeasurably small increment and increase individual mineral constituents by less than 0.1 to 0.4 percent.

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SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES--OHIO REGION

BLOYD, R. M. JR

GEOLOGICAL SURVEY, RESTON, VA.

AVAILABLE FROM SUPT. OF DOCUMENTS, GPO, WASHINGTON, D.C. 20402 - $1.75 (PAPER COVER). PROFESSIONAL PAPER 813-A, 1974. 41 P, 22 FIG, 13 TAB, 25 REF.,

Journal Announcement: SWRAU821

GROUNDWATER IN THE OHIO REGION IS A LARGE, IMPORTANT, AND MANAGEABLE RESOURCE THAT SHOULD HAVE A SIGNIFICANT ROLE IN REGIONAL WATER DEVELOPMENT. ON THE BASIS OF A COMPARISON OF GROUNDWATER WITHDRAWALS WITH ESTIMATED GROUNDWATER RECHARGE, THE GROUNDWATER RESOURCES PROBABLY WILL NOT BE USED AT FULL POTENTIAL UNDER EXISTING DEVELOPMENT PLANS. ANNUAL GROUNDWATER USE (1960) BY MUNICIPALITIES AND RURAL RESIDENTS WAS ABOUT 1,000 MILLION GALLONS PER DAY. AVERAGE ANNUAL REGIONAL GROUNDWATER RECHARGE IS ABOUT 35,000 MGD. THEREFORE, BASE-YEAR (1960) MUNICIPAL AND RURAL GROUNDWATER USE IS ONLY ABOUT 3% OF RECHARGE. ANNUAL REGIONWIDE GROUNDWATER USE (1965) BY INDUSTRY ALSO IS ONLY ABOUT 3% OF RECHARGE. TOTAL POTABLE GROUNDWATER AVAILABLE FROM STORAGE IN THE OUTWASH AND ALLUVIAL AQUIFERS IN THE OHIO RIVER VALLEY AND THE SUBBASINS IS ABOUT 23,000 BILLION GALLONS. THIS IS ABOUT FOUR TIMES THE FLOOD-CONTROL STORAGE OF ALL OHIO REGION CORPS OF ENGINEERS RESERVOIRS CONSTRUCTED, UNDER CONSTRUCTION, OR IN ADVANCE PLANNING AS OF JULY 1965. APPROXIMATELY 85,000 BILLION GALLONS OF POTABLE GROUNDWATER IS AVAILABLE FROM STORAGE IN AQUIFERS OTHER THAN THE OUTWASH AND ALLUVIAL AQUIFERS. (WOODARD-USGS)

Hydrology of Area 7, Eastern Coal Province, Ohio

Engelke, M. J., Jr., Roth, D. K., and others, 1981

U.S. Geological Survey Water-Resources Investigations Open-File Report 81-815, 60 p.

Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties)

Helgesen, J. O.; Razem, A. C.

Geological Survey, Columbus, OH. Water Resources Div.

Geological Survey Open-File Report 81-913 (WRI), 1981. 25 p, 14 Fig, 2 Tab, 3 Ref.,

Journal Announcement: SWRA1512

Ground-water conditions during coal strip-mining in two small watersheds are described as part of an ongoing study of effects of mining on hydrologic systems. Each watershed was underlain by stratified sedimentary rocks containing two perched aquifers above clays which underlaid the major coal seams. Mining involved removing the over-burden rocks, including the top aquifer, stripping the top coal seam, and recontouring the overburden spoils to the approximate premining shape of the watershed. Water-levels in the top aquifer declined as mining neared the watersheds, but destruction of observation wells precluded a record of the decline during mining of the watersheds. Depletion of the top aquifer was reflected in stream base flow, which was reduced and more highly mineralized after mining. Initial saturated thickness of replaced overburden spoils ranged from 0 to 4 feet, based on data from observation wells installed immediately after reclamation. Down-hole specific conductance measurements of water in the spoils suggest the presence of more highly mineralized water than that in the premining top aquifer. No immediate significant effects of mining are evident on groundwater levels or quality beneath the stripped coal. (USGS)

Surface Water Quality in Ohio's Coal Regions
Helsel, Dennis R., and Pfaff, Christine L.
U.S. Geological Survey Papers Presented Before the Abandoned Mine Reclamation Symposium

Water quality at base flow for 150 streams located within the coal producing areas of eastern Ohio was inventoried during 1975-76 in a two-phase study. Phase one, a reconnaissance to relate water quality to land use, demonstrated significant differences in levels of pH, total alkalinity, total aluminum, specific conductance, and sulfate between unmined watersheds and those containing abandoned coal mines Reclaimed basins produced waters similar to those from unmined watersheds for pH, total iron, and total aluminum concentrations, whereas specific conductance and sulfate concentrations were near those of abandoned mine streams. Alkalinity and pH varied not only with type of mining operation but with the underlying geologic formation.

In the second phase of this study, four watersheds were selected from among the first-phase sampling sites. Types of mining represented were abandoned drift mine, abandoned surface mine, active surface mine, and reclaimed surface mine. Samples from drainage upstream, at, and downstream from the mine sites were collected to describe any chemical changes within the watersheds resulting from mining activity. The active surface mine site did not significantly affect quality in the main stream channel, whereas water quality was altered in the other three streams because of mining activity.

Hydrology of Area 3, Eastern Coal Province, Pennsylvania
Herb, W. J.; Shaw, L. C.; Brown, D. E.
Geological Survey, Harrisburg, PA. Water Resources Div.
Geological Survey Open-File Report 81-537 (WRI), September 1981. 88 p, 65 Fig, 26 Tab, 29 Ref, Append.,
Journal Announcement: SWRA1511

Hydrologic data are presented for area 3 of the Eastern Coal Province, 4,077 square miles of the lower Allegheny River basin in western Pennsylvania. Seventy-three streams were sampled three times during the 1979 and 1980 water years for specific conductance, pH, acidity, alkalinity, dissolved and total iron, dissolved and total manganese, dissolved sulfate, and dissolved solids. Benthic invertebrate populations were determined and botom material samples were analyzed for metals. Sixteen streams had pH, acidity, alkalinity, total iron, total manganese, and dissolved sulfate indicative of acid-mine drainage. These streams were most common in the Redbank and Blacklick Creek basins and in the Conemaugh and lower Kiskiminetas River basins. Benthic invertebrates were not found in 11 of 64 streams sampled. An additional 13 streams had low benthic invertebrate diversity indices. Low diversity indices were most common in the southern part of area 3. Low flow, mean flow, peak flow, and flow duration data are presented for gaging stations in area 3. Techniques for estimating these data for ungaged sites are presented and referenced. The functions of, and access to, the National Water Data Exchange, National Water Data Storage and Retrieval System, and Office of Water Data Coordination are explained. (USGS)

Water Resources Data for Ohio Coal Areas, Water Year 1979--v. 3, available from the National Technical Information Service, Springfield, VA 22161 as PB81-105405, in paper copy in microfiche.

Herbert, L. R.,

U.S. Geological Survey Water-Data Report OH-79-3, July 1980, 160 p., 2 fig., 3 tables.

Water Resources of the Black Hand Sandstone Member of the Cuyahoga Formation and Associated Aquifers of Mississippian Age in Southeastern Ohio

Norris, Stanley E., and Mayer, Gregory C.

U.S. Geological Survey Open-File Report 82-170, 72 pages.

The Black Hand Sandstone Member of the Cuyahoga Formation and associated aquifers of Mississippian age, including the Allensville Conglomerate, member of the Logan Formation, were investigated in a 1,500-square-mile area, parts of five counties in southeastern Ohio. The aquifers crop out in western Vinton, western Hocking, and southwestern Fairfield Counties. They dip southeastward about 35 feet per mile, becoming progressively more deeply buried until at Lake Hope, in northeastern Vinton County, the aquifers are the deepest sources of potable ground water in Ohio, occurring at depths locally exceeding 700 feet.

These aquifers are the chief sources of water beneath the coal-bearing rocks of the Pennsylvanian System and are widely used for farm and home requirements. Specific capacities of wells are low, exceeding 1 gallon per minute per foot of drawdown only in scattered areas.

At McArthur, in Vinton County, the aquifers yield about 300,000 gallons per day for municipal and industrial use, but withdrawal has been accompanied by declining ground-water levels during the past 10 years in a 10-square-mile area. Transmissivity, determined from wells open to both the Black Hand Sandstone Member and Allensville Conglomerate Member at McArthur's west municipal well field, is about 135 square feet per day.

The ground water is predominately of the sodium bicarbonate or calcium bicarbonate type in the central part of the area and changes, as it moves downdip, to a sodium chloride bicarbonate type. Along the eastern boundaries of Hocking and Vinton Counties, the aquifers are below the common depth of wells and are presumed to be potable but contain water too salty for ordinary use. Locally, the aquifers are contaminated by brine from oil and gas wells.

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio

Pfaff, C. L.; Helsel, D. R.; Johnson, D. P.; Angelo, C. G.

Geological Survey, Columbus, OH. Water Resources Div.

Geological Survey Water Resources Investigations Open-File Report 81-409, October 1981. 98 p, 17 Fig, 7 Tab, 43 Ref, Append.,

Journal Announcement: SWRA1511

Water quality in the coal-producing areas of eastern Ohio was studied in a two-phase investigation between May 1975 and August 1976. Results of phase one, a reconnaissance of water quality at 150 sites, indicated that acid mine drainage generally occurred where abandoned drift or strip mines were located, whereas areas characterized by reclaimed or active strip mines showed few instances of acid drainage. Phase two was a detailed study of four small basins: One contained abandoned drift mines; the second, abandoned strip mines; the third, reclaimed strip mines; the last, active strip mines. Results of phase two were similar to those of phase one. (USGS)

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia

Roth, D. K.; Engelke, M. J. Jr

Geological Survey, Columbus, OH. Water Resources Div.

Geological Survey Open-File Report 81-343 (WRI), July, 1981. 62 p, 41 Ref, 3 Append.,

Journal Announcement: SWRA1511

Area 4 (one of the 24 hydrologic areas defining the Eastern Coal Province) is located at the northern end of the

Eastern Coal Province in eastern Ohio, northern West Virginia, and western Pennsylvania. It is part of the upper Ohio River basin, which includes the Beaver, Mahoning, and Shenango Rivers. The area is underlain by rocks of the Pottsville, Allegheny, Conemaugh, Monongahela Groups (or Formations) and Dunkard Group. Area 4 has a temperate climate with an annual average rainfall of 38 to 42 inches, most of its area is covered by forest. The soils have a high erosion potential where the vegetation cover is removed. In response to Public Law 95-87, 132 sites were added to the existing surface-water data-collection network in area 4. At these added sites, collected data includes discharge, water quality, sediment, and biology. The data are available from computer storage through the National Water Data Exchange (NAWDEX) or the published annual Water Resources Data reports for Ohio, Pennsylvania, and West Virginia. Hydrologic problems related to mining are: (1) Erosion and increased sedimentation, and (2) degradation of water quality. Erosion and sedimentation are associated chiefly with surface mining. Sediment yields increase drastically when vegetation is removed from the highly erosive soils. Degradation of water quality can be caused by acid-mine drainage from underground and surface mining. More than half the acid-mine drainage effluent in area 4 comes from underground mines. The rest seeps from abandoned surface mines. Usually in reclaimed surface mines the overburden is replaced in such a short time after the coal is taken out that oxidation of acid-forming minerals, commonly pyrite or marcasite, is not complete or is neutralized by the buffering action of calcareous minerals in the soils. (USGS)

Water Resources Data for Ohio, (published annually since 1975).
Geological Survey Columbus, Ohio. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161.

Water resources data for Ohio consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, Federal, and other governmental agencies in Ohio. (Woodard-USGS)

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Rainfall-Runoff Hydrograph and Basin Characteristics Data for Small Streams in Oklahoma
Bergman, D. L.; Huntzinger, T. L.
Geological Survey, Oklahoma City, OK. Water Resources Div.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $42.00, Microfiche $4.00. Geological Survey Open-File Report 81-824, September, 1981. 318 p, 2 Fig, 3 Tab, 4 Ref.,
Journal Announcement: SWRA1509
Rainfall with concordant runoff events recorded at 45 gages located in drainage basins of less than 30 square miles in Oklahoma are summarized. Selected basin characteristics which relate to storm runoff are described and tabulated for each gage site summarized. A tabulation is included which identifies drainage basins that produce atypical rainfall-runoff distribution as a result of regulation by upstream flood-retention structures. (USGS)

Geology and oil and gas resources of Craig County, Oklahoma
Branson, C. C., Huffman, G. G., and Strong, D. M., 1965
Oklahoma Geological Survey Bulletin 99, 109 p.

Geology and coal resources of the Henryetta mining district, Okmulgee County, Oklahoma
Dunham, R. J., and Trumbull, J. V. A., 1955
U.S. Geological Survey Bulletin 1015-F, p. 183-225.

Groundwater in the Verdigris River basin, Kansas and Oklahoma
Fader, S. W., and Morton, R. B., 1975
U.S. Geological Survey Open-File Report 75-365, 26 p.

Investigation of the coal reserves in the Ozarks section of Oklahoma and their potential users
Friedman, S. A., 1974
Oklahoma Geological Survey Final Report to the Ozarks Regional Commission, July 10, 1974, 117 p.

Map of eastern Oklahoma showing locations of active coal mines, 1977-79
Friedman, S. A., and Sawyer, K. C., 1982
Oklahoma Geological Survey Map GM-24, 1 sheet, scale 1:500,000

Geology of the Greenwood quadrangle, Arkansas-Oklahoma
Haley, B. R., and Hendricks, T. A., 1968
U.S. Geological Survey Professional Paper 536-A, 15 p.

Geology of the Van Buren and Lavaca quadrangles, Arkansas and Oklahoma
Haley, B. R., and Hendricks, T. A., 1971
U.S. Geological Survey Professional Paper 657-A, 41 p.

Ground-Water Records for Eastern Oklahoma, Part 2 - Water-Quality Records for Wells, Test-Holes, and Springs
Havens, J. S.
Geological Survey, Oklahoma City, OK. Water Resources Div.
Open-file report 78-357, May 1978. 139 p.,
Journal Announcement: SWRA1121

The U.S. Geological Survey has collected data on Oklahoma's ground-water resources since 1934. This report makes available both published and unpublished water-quality records for approximately 1,740 wells, test holes, and springs in 39 counties in eastern Oklahoma. (Woodard-USGS)

Ground-water records for northeastern Oklahoma--Part 1. Records of wells, test holes, and springs
Havens, J. S., and Bergman, D. L., 1976
U.S. Geological Survey Open-File Report, 100 p.

High-flow frequencies for selected streams in Oklahoma
Huntzinger, T. L., 1978b
U.S. Geological Survey Open-File Report 78-161, 30 p.

Low-flow characteristics of Oklahoma streams
Huntzinger, T. L., 1978c
U.S. Geological Survey Open-File Report 78-166, 93 p.

Maps and description of disturbed and reclaimed surface-mined coal lands in eastern Oklahoma
Johnson, K. S., 1974
Oklahoma Geological Survey Map GM-17, 12 p. 3 maps, scale 1:125,000.

GEOLOGY AND EARTH RESOURCES OF OKLAHOMA
JOHNSON, K. S.; BRANSON, C. C.; CURTIS, N. M. JR; HAM, W. E.; MARCHER, M. V.
GEOLOGICAL SURVEY, NORMA, OKLA.
EDUCATIONAL PUBLICATION 1, 1972. 8 P, 7 MAP, 1 TAB.,
Journal Announcement: SWRA0622

THIS ATLAS OF MAPS AND CROSS SECTIONS DESCRIBES GEOLOGY AND EARTH RESOURCES FOR OKLAHOMA. ROCKS OF EVERY GEOLOGIC PERIOD CROP OUT IN OKLAHOMA. ALTHOUGH MOST OF THESE ROCKS ARE OF SEDIMENTARY ORIGIN, CONSOLIDATED FROM SEDIMENTS DEPOSITED DURING THE PALEOZOIC ERA, THE OLDEST ARE PRECAMBRIAN GRANITES AND RHYOLITIES FORMED 1.05 TO 1.35 BILLION YEARS AGO. AVERAGE ANNUAL PRECIPITATION RANGES FROM ABOUT 16 INCHES IN THE WESTERN PANHANDLE TO AS MUCH AS 56 INCHES IN THE SOUTHEASTERN PART OF THE STATE. MAJOR GROUNDWATER AQUIFERS ARE STREAM DEPOSITS (ALLUVIUM, TERRACE DEPOSITS, AND THE OGALLALA FORMATION), LIMESTONE, SANDSTONE, AND GYPSUM. THESE AQUIFERS

ARE ESTIMATED TO CONTAIN MORE THAN 300 MILLION ACRE-FEET OF WATER. THE ENTIRE STATE IS DRAINED BY THE ARKANSAS AND RED RIVERS AND THEIR TRIBUTARIES. EACH YEAR APPROXIMATELY 13 MILLION ACRE-FEET OF WATER FLOWS INTO THE STATE THROUGH THESE STREAMS, 22 MILLION ACRE-FEET IS ADDED BY PRECIPITATION, AND 35 MILLION ACRE-FEET FLOWS OUT. THE MINERAL CONTENT OF GROUNDWATER FROM STREAM DEPOSITS, LIMESTONE, AND SANDSTONE IS TYPICALLY LOW TO MODERATE, AND THE WATER IS SUITABLE FOR MOST PURPOSES. HIGHLY MINERALIZED WATER, UNFIT FOR NEARLY ANY USE, IS PRESENT BENEATH FRESHWATER IN ALL PARTS OF THE STATE. (WOODARD-USGS)

Bibliography of abandoned coal-mine lands in Oklahoma
Johnson, K. S., Kidd, C. M., and Butler, R. C., 1981
Oklahoma Geological Survey Special Publication 81-2, 84 p.

Geology and fuel resources of the southern part of the Oklahoma coal field, Part 2. The Lehigh district, coal, Atoka, and Pittsburg Counties
Knechtel, M. M., 1937
U.S. Geological Survey Bulletin 874-B, p. 91-149

Statistical Summaries of Surface-Water-Quality Data for Selected Sites in Oklahoma, Through the 1975 Water Year
Kurklin, J. K.
Geological Survey, Oklahoma City, OK. Water Resources Div.
Geological Survey open-file report 79-219, May 1979. 171 p, 1 Fig, 5 Tab, 4 Ref.,
Journal Announcement: SWRA1303

Statistical summaries of surface-water-quality data for 47 streams in Oklahoma have been compiled. ta for the period of record through the 1975 water year at each site were used to develop regression equations for specific conductance-constituent relationships for calcium, magnesium, sodium, sodium plus potassium, bicarbonate, sulfate, chloride, silica, and dissolved solids. Tables include minimum, mean, and maximum values for selected constituents for the period of record through the 1975 water and for individual water years. (Woodard-USGS)

NORTHEASTERN OKLAHOMA
MARCHER, M. V.; BINGHAM, R. H.
GEOLOGICAL SURVEY, OKLAHOMA CITY, OKLA.
OKLAHOMA GEOLOGICAL SURVEY MAP HA-2, 4 SHEETS, 1971. 2 FIG, 5 MAP, 4 TAB, 20 REF.,
Journal Announcement: SWRA0622

THIS 4-SHEET ATLAS DESCRIBES THE WATER RESOURCES FOR THE TULSA, OKLAHOMA, AREA. SURFACE WATER IS THE MAJOR SOURCE OF WATER USED IN THE TULSA QUADRANGLE. THE TOTAL AMOUNT OF WATER USED IN 1968 IS ESTIMATED AT 25.4 BILLION GALLONS. APPROXIMATELY

86% OF THIS AMOUNT, OR ABOUT 21.8 BILLION GALLONS, WAS TAKEN FROM THE LAKES AND RIVERS OF THE AREA; THE REMAINING 3.6 BILLION GALLONS WAS PROVIDED BY GROUNDWATER DEVELOPMENT. THE MAJOR USE OF WATER WAS FOR MUNICIPAL AND INDUSTRIAL PURPOSES, WHICH ACCOUNTED FOR ABOUT 24 BILLION GALLONS; RURAL DOMESTIC USE ACCOUNTED FOR THE REMAINING 1.4 BILLION GALLONS. THE MOST INTENSIVE AREA OF GROUNDWATER DEVELOPMENT IS IN OTTAWA COUNTY, WHERE, IN 1968, ABOUT 1.7 BILLION GALLONS WAS PUMPED FROM DEEP AQUIFERS FOR MUNICIPAL AND INDUSTRIAL USE. BECAUSE OF THE DIFFICULTY IN OBTAINING SUFFICIENT WATER OF GOOD QUALITY IN MANY PARTS OF THE AREA, 33 RURAL WATER DISTRICTS HAD BEEN ESTABLISHED BY THE END OF 1967. THESE APPROXIMATELY 15,000 PEOPLE; ALL THE WATER WAS TAKEN FROM SURFACE-WATER SOURCES. (WOODARD-USGS)

RECONNAISSANCE OF THE WATER RESOURCES OF THE FORT SMITH QUADRANGLE, EAST-CENTRAL OKLAHOMA
MARCHER, MELVIN V.
GEOLOGICAL SURVEY, OKLAHOMA CITY, OKLA.
OKLAHOMA GEOLOGICAL SURVEY HYDROLOGIC ATLAS 1, 1969. 4 SHEETS, TEXT, 6 FIG, 5 MAP, 3 TAB, 30 REF.,
Journal Announcement: SWRA0312

THE GEOLOGY AND WATER RESOURCES OF THE FORT SMITH QUADRANGLE, OKLAHOMA ARE SHOWN BY A 4-SHEET HYDROLOGICAL ATLAS CONSISTING OF A GEOLOGICAL MAP, A GROUNDWATER AVAILABILITY MAP, A GROUNDWATER QUALITY MAP, A MAP SHOWING DISTRIBUTION OF PRECIPITATION, HYDROGRAPHS, TABULATED DATA, AND DESCRIPTIVE TEXT. IN SOME PARTS OF THE FORT SMITH QUADRANGLE, WELLS READILY YIELD SEVERAL HUNDRED GALLONS OF WATER PER MINUTE SUITABLE FOR MOST PURPOSES, WHEREAS IN OTHER PARTS, SUPPLIES OF WATER SUFFICIENT FOR DAILY HOUSEHOLD USE ARE DIFFICULT TO OBTAIN AND MUCH OF THIS WATER IS OF POOR QUALITY. DIFFERENCES IN WELL YIELD AND WATER QUALITY ARE CONTROLLED MAINLY BY THE TYPE OF ROCK IN WHICH A WELL IS COMPLETED. IN GENERAL, ALLUVIUM IS THE MOST FAVORABLE TYPE OF ROCK FOR LARGE WELL YIELDS, FOLLOWED BY TERRACE DEPOSITS IN LOCAL AREAS AND THEN, IN ORDER OF DECREASING FAVORABILITY, WEATHERED CHERT, LIMESTONE, SANDSTONE, AND SILTSTONE, WITH SHALE THE LEAST FAVORABLE. IN ADDITION TO ROCK TYPE, GEOLOGIC STRUCTURE ALSO AFFECTS THE OCCURRENCE OF GROUNDWATER, PARTICULARLY IN THE NORTHEASTERN PART OF THE AREA WHERE SPRINGS AND SOME OF THE WELLS OF LARGER YIELD APPARENTLY OBTAIN WATER FROM ROCKS BROKEN BY FAULTING. MINOR STREAMS IN THE AREA GO DRY OR NEARLY DRY ALMOST EVERY YEAR. ALLUVIUM YIELDS GROUNDWATER OF THE BEST QUALITY AND SHALE TO POOREST, WHEREAS OTHER ROCK TYPES YIELD WATER WITH A QUALITY SOMEWHERE BETWEEN. GROUNDWATER THAT HAS BEEN IN CONTACT WITH COAL BEDS IS USUALLY HIGHLY MINERALIZED AND, IN SOME PLACES, UNFIT TO DRINK. COAL MINING AND OIL- AND GAS-FIELD DEVELOPMENT MAY ADVERSELY AFFECT THE WATER QUALITY LOCALLY. (KNAPP-USGS)

Statistical summaries of streamflow records, Oklahoma, through 1974

Mize, L. D., 1975
U.S. Geological Survey Open-File Report, 399 p.

Ground water in the Grand (Neosho) River basin, Kansas and Oklahoma
Morton, R. B., and Fader, S. W., 1975
U.S. Geological Survey Open-File Report 75-366, 35 p.

Geology and mineral resources of Washington County, Oklahoma
Oakes, M. C., 1940
Oklahoma Geological Survey Bulletin 62, 208p.

Geology and mineral resources of Tulsa County, Oklahoma
Oakes, M. C., 1952
Oklahoma Geological Survey Bulletin 69, 234 p

Flood characteristics of Oklahoma streams
Sauer, V. B., 1974
U.S. Geological Survey Water-Resources Investigations 52-73, 301 p.

Mineral resources of northeastern Oklahoma
Siebenthal, C. E., 1908
U. S. Geological Survey Bulletin 340-C, 43 p

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978
Stoner, J. D.
Geological Survey, Oklahoma City, OK. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-142902, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-33, May, 1981. 297 p, 6 Fig, 3 Tab, 14 Ref.,
Journal Announcement: SWRA1510
Water-quality data in the Arkansas River mainstem and the Verdigris, Neosho, and Illinois River basins within Oklahoma were examined for water type and suitability for public water supply and irrigation use. The classification of water type was based on the relation of the major ions: each other within the range of measured specific conductance. The judgement of suitability for public supply use was based on the concentration levels and distributions of selected constituents. The Wilcox irrigation classification scheme was used to relate sodium concentrations and the salinity distribution to the use of the water for irrigation. The possibility of phytotoxic effects from boron was discussed where data were available. (USGS)

Index of published surface-water-quality data for Oklahoma,

1946-1975
Stoner, J. D., 1977
U.S. Geological Survey Open-File Report 77-204, 212 p.

GEOHYDROLOGY OF THE LOWER VERDIGRIS RIVER VALLEY BETWEEN MUSKOGEE AND CATOOSA, OKLAHOMA
TANAKA, H. H.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
AVAILABLE FROM GPO, WASHINGTON, D C 20402 - PRICE 75 CENTS. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1999-A, 1972. 23 P, 4 FIG, 2 PLATE, 5 TAB, 6 REF. ,
Journal Announcement: SWRA0519

ALLUVIUM IS THE PRINCIPAL AQUIFER ALONG THE VERDIGRIS RIVER BETWEEN MUSKOGEE AND CATOOSA, OKLA. YIELDS OF 1 TO 10 GALLONS OF WATER PER MINUTE, ADEQUATE FOR MOST DOMESTIC AND STOCK USES, ARE AVAILABLE IN ALMOST ALL AREAS UNDERLAIN BY ALLUVIUM. IN PLACES WHERE THE PROPORTION OF GRAVEL TO FINE MATERIAL IS HIGH, YIELDS RANGING FROM 10 TO 30 GPM ARE POSSIBLE FROM LARGE-DIAMETER WELLS. TERRACE DEPOSITS YIELD SMALL AMOUNTS OF WATER (1 TO FLUCTUATIONS, IN RESPONSE TO SEASONAL CHANGES IN RECHARGE AND DISCHARGE, RANGE FROM 1 TO 5 FEET. LONG-TERM FLUCTUATIONS ARE ABOUT 10 FEET IN THE ALLUVIUM AND LESS THAN 5 FEET IN THE TERRACE DEPOSITS. RECHARGE TO THE ALLUVIUM IS MAINLY BY PRECIPITATION. RECHARGE MAINTAINS GROUNDWATER LEVELS ABOVE THE LEVEL OF THE VERDIGRIS RIVER. DISCHARGE FROM THE ALLUVIUM IS BY SEEPAGE INTO THE RIVER AND ITS TRIBUTARIES AND BY EVAPOTRANSPIRATION. GENERALLY, THE QUALITY OF THE WATER IN THE ALLUVIUM AND TERRACE DEPOSITS IS SUITABLE FOR DOMESTIC, STOCK, AND IRRIGATION USES. (KNAPP-USGS)

FLOODFLOWS FROM SMALL DRAINAGE AREAS IN OKLAHOMA: PROGRESS REPORT AND DATA COMPILATION
THOMAS, W. O. JR; CORLEY, R. K.
GEOLOGICAL SURVEY, OKLAHOMA CITY, OKLA.
OPEN-FILE REPORT, 1974. 50 P, 19 FIG, 8 TAB, 13 REF.,
Journal Announcement: SWRA0716

ANNUAL PEAK DISCHARGES AND BASIN AND CLIMATIC CHARACTERISTICS ARE SUMMARIZED FOR 103 SMALL-STREAM SITES IN OKLAHOMA. THE U.S. GEOLOGICAL SURVEY RAINFALL-RUNOFF MODEL WAS CALIBRATED FOR SIX SMALL WATERSHEDS. THE RAINFALL-RUNOFF MODEL CAN BE USED TO EXTEND THE LENGTH OF FLOOD RECORDS FOR SMALL WATERSHEDS. RECORDS FROM FOUR SMALL WATERSHEDS WERE EXTENDED BY THE MODEL, AND SYNTHETIC FREQUENCY CURVES WERE COMPUTED FOR THESE SITES TO SHOW APPLICABILITY OF THE MODEL. (KNAPP-USGS)

Techniques for Estimating Flood Discharges for Oklahoma Streams
Thomas, W. O. Jr; Corley, R. K.
Geological Survey, Reston, VA. Water Resources Div.; and Geological Survey, Oklahoma City, OK. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-273 402, Price codes: A09 in paper copy, A01 in microfiche. Water-Resources Investigations 77-54,

June 1977. 170 p, 20 fig, 5 tab, 13 ref, 3 append.,
Journal Announcement: SWRA1106
Statewide(Oklahoma) regression equations are defined for estimating peak discharges of floods having recurrence intervals ranging from 2 to 500 years. Contributing drainage area, main-channel slope and mean annual precipitation are the independent variables required for estimating flood discharges for rural streams. For urban streams the percentage of the basin that is impervious and served by storm sewers also is required. The regression equations are applicable for watersheds draining less than 2,500 sq mi that are not significantly affected by regulation. For rural streams, the regression equations are presented in graphical form for easy application. Annual peak data, basin and climatic characteristics, log-Pearson Type III statistics, and the flood-frequency relations are presented for 188 gaging stations. (Woodard-USGS)

Coal resources of Oklahoma
Trumbull, J. V. A., 1957
U. S. Geological Survey Bulletin 1042-J, p. 307-382

Water Resources Data for Oklahoma, published annually since 1975.
Geological Survey, Oklahoma City, OK. Water Resources Div.
Available from the National Technical Information Service, Springfield,
Water resources data for Oklahoma consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality lakes or reservoirs. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oklahoma. (Kosco-USGS)

WATER RESOURCES INVESTIGATIONS IN OKLAHOMA, 1968
GEOLOGICAL SURVEY, WASHINGTON, D.C.
GEOLOGICAL SURVEY REPORT OF INVESTIGATIONS FOLDER, 1 SHEET, 1968. 6 FIG, 1 MAP.,
Journal Announcement: SWRAU520
WATER RESOURCES STUDIES AND INVESTIGATIONS OF THE U. S. GEOLOGICAL SURVEY IN OKLAHOMA ARE SUMMARIZED. A SELECTED BIBLIOGRAPHY OF MATERIAL CONCERNING THE STATE IS INCLUDED. A LIST IS GIVEN OF STATE AND FEDERAL AGENCIES, COUNTIES, AND CITIES WHO COOPERATE IN DIFFERENT PARTS OF THE PROGRAM. THE HYDROLOGIC DATA NETWORK CONSISTS OF 160 PRIMARY, SECONDARY, AND WATER MANAGEMENT STREAMFLOW STATIONS; 254 GROUNDWATER OBSERVATION WELLS; AND 35 WATER QUALITY OBSERVING SITES. SMALL STATE MAPS SHOW PRINCIPAL SOURCES OF GROUNDWATER, AVERAGE ANNUAL

PRECIPITATION, AVERAGE ANNUAL RUNOFF, DISCHARGE OF THE PRINCIPAL RIVERS, AND THE CHEMICAL QUALITY OF THE RIVERS. A MAP, SCALE 35 MI TO THE INCH, SHOWS BY SYMBOLS, NUMBERS, AND COLORED OUTLINE THE HYDROLOGIC DATA NETWORK AND INVESTIGATIONS IN OKLAHOMA IN JULY 1968. (WOODARD-USGS)

Water-Resources Investigations of the U.S. Geological Survey, Water Resources Division, Oklahoma District

Geological Survey, Oklahoma City. OK. Water Resources Div.

Oklahoma District report, January 1978. 91 p, 6 fig, 2 tab, 114 ref.,

Journal Announcement: SWRA1120

This report is a summary of the 1978 program of the U.S. Geological descriptions of all active projects and the current status of each. A list of all published reports related to the water resources of Oklahoma is given. It contains listings of all streamflow gaging stations, water quality stations, and reservoir stations which the Geological Survey operates or publishes through cooperation with other State, local, and Federal agencies. Included are discontinued surface water and water quality stations for which the Geological Survey has published records. Stations are listed by type and by cooperator and the number of stations funded by each cooperator is summarized. Maps show the locations of various types of stations, the locations of selected ground-water projects and an index of the two-degree sheets in Oklahoma for which hydrologic reconnaissance studies have been made. (Woodard-USGS)

Variations in the chemical character of the Susquehanna River at Harrisburg, Pennsylvania
Anderson, P. W., 1963,
U. S. Geological Survey Water-Supply Paper 1779-B, 17 p.

Field Investigation of Mine Waters in the northern Anthracite Field, Pennsylvania
Barnes, Ivan, Stuart, W. T., and Fisher, D. W., 1964
U. S. Geological Survey Professional Paper 473-B, 8 p.

GUIDE TO THE AVAILABILITY OF HYDROLOGIC DATA, GREATER PITTSBURGH REGION, PENNSYLVANIA
BEALL, R. M.
GEOLOGICAL SURVEY, HARRISBURG, PA.
OPEN-FILE REPORT 76-352, MAY 1976. 12 P, 1 PLATE, 33 REF.,
Journal Announcement: SWRA0923

ACTIVE PRIMARY-COLLECTION SITES FOR HYDROLOGIC DATA ARE SHOWN ON A MAP OF THE GREATER PITTSBURGH REGION (ALLEGHENY, ARMSTRONG, BEAVER, BUTLER, WASHINGTON, AND WESTMORELAND COUNTIES IN SOUTHWESTERN PENNSYLVANIA). THE SOURCES OF DATA--BY PUBLICATION OR RESPONSIBLE AGENCY--ARE DESCRIBED. SECONDARY DATA COLLECTION SITES HAVE NOT BEEN SHOWN ON THE MAP, BUT SEVERAL AGENCIES INVOLVED IN THIS ACTIVITY HAVE BEEN LISTED. HYDROLOGIC DATA ARE COLLECTED AT THE FOLLOWING NUMBERS OF IDENTIFIED SITES UNDER THE AUSPICES OF FEDERAL, STATE, AND INTERSTATE ORGANIZATIONS: PRECIPITATION OR TEMPERATURE 39, SURFACE-WATER STAGE OR DISCHARGE 82, SURFACE-WATER QUALITY 69, AND GROUND-WATER LEVELS 7. (WOODARD-USGS)

STREAM RECONNAISSANCE FOR NUTRIENTS AND OTHER WATER-QUALITY PARAMETERS, GREATER PITTSBURGH REGION, PENNSYLVANIA
BEALL, R. M.
GEOLOGICAL SURVEY, CARNEGIE, PA.
AVAILABLE FROM THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA 22161 AS PB-241 493, $3.75 IN PAPER COPY, $2.25 IN MICROFICHE. WATER-RESOURCES INVESTIGATIONS 50-74, FEBRUARY 1975. 47 P, 7 FIG, 2 PLATE, 4 TAB, 30 REF.,
Journal Announcement: SWRA0817

EIGHTY-FIVE STREAM SITES IN AND NEAR THE SIX-COUNTY GREATER PITTSBURGH REGION WERE SAMPLED IN MID-JUNE 1971 AND AGAIN IN MID-OCTOBER 1972. DATA ARE REPORTED FOR 89 SITES (INCLUDING 4 SUBSTITUTE SITES SAMPLED IN THE SECOND PERIOD). DRAINAGE AREAS OF THE BASINS SAMPLED RANGED FROM 4.1 TO 19,500 SQUARE MILES (10.6 TO 50,500 SQUARE KILOMETERS). THE CHEMICAL ANALYSES INCLUDE CONSTITUENTS OF THREE GENERAL CLASSES: (1) NUTRIENTS, (2) ACTIVITY INDICATORS, AND (3) DOMINANT ANIONS. NUTRIENT CONCENTRATIONS WERE HIGH ENOUGH TO INDICATE POTENTIAL PROBLEMS AT ABOUT A QUARTER OF THE SAMPLING SITES. TEMPERATURE, DISSOLVED OXYGEN, AND PH VALUES INDICATED A

GENERALLY FAVORABLE CAPACITY FOR REGENERATION OR RECOVERY FROM DEGRADATION, ALTHOUGH A NUMBER OF STREAMS EAST OF THE ALLEGHENY AND MONONGAHELA RIVERS ARE MARGINAL OR LACKING IN THAT CAPACITY. REGIONALLY, SULFATE IS THE DOMINANT ION AND WAS OBSERVED IN CONCENTRATIONS OF 40 MILLIGRAMS PER LITRE OR MORE AT 90% OF THE SITES. BICARBONATE EXCEEDED 100 MILLIGRAMS PER LITRE AT 22 SITES. A MODERATE TO HIGH DEGREE OF MINERALIZATION, AS INDICATED BY CONDUCTANCE READINGS OF MORE THAN 500 MICROMHOS PER CENTIMETER AT HALF OF THE SAMPLING SITES, IS A CHARACTERISTIC OF THE REGION'S SURFACE WATERS. (WOODARD-USGS)

GROUNDWATER IN PENNSYLVANIA
BECHER, A. E.
GEOLOGICAL SURVEY, HARRISBURG, PA.
AVAILABLE FROM BUREAU OF PUBLICATIONS, TENTH AND MARKET STREETS, HARRISBURG, PENN 17125. PENNSYLVANIA GEOLOGIC SURVEY EDUCATIONAL SERIES NO 3, 1970. 42 P, 29 FIG, 1 MAP, 2 TAB, 46 REF.,
Journal Announcement: SWRA0411

THE EXISTING KNOWLEDGE OF THE GROUNDWATER RESOURCES OF PENNSYLVANIA IS SUMMARIZED. IT WAS WRITTEN TO PROVIDE INDUSTRIAL AND CIVIL PLANNERS, DEVELOPERS, MANAGERS, AND THE PUBLIC WITH SUFFICIENT INFORMATION ABOUT STATEWIDE WATER RESOURCES TO MAKE INTELLIGENT, FUNDAMENTAL DECISIONS ABOUT THE FUTURE USE, DEVELOPMENT, AND PROTECTION OF THE GROUNDWATER. PENNSYLVANIANS USED ABOUT 6.6 BGD (BILLION GALLONS PER DAY) OF WATER IN 1966, EXCLUDING ELECTRIC POWER PLANT USE. ALTHOUGH ONLY 11% OF THE WATER WAS TAKEN DIRECTLY FROM GROUNDWATER SOURCES, 25 TO 35% OF THE PEOPLE DEPEND ON GROUNDWATER FOR THEIR PERSONAL NEEDS. IN ADDITION, 55% OF WATER COMPANIES OBTAIN ALL THEIR WATER, AND ANOTHER 13% OBTAIN PART OF THEIR WATER, FROM GROUNDWATER SOURCES. TWENTY-ONE OF THE 67 PENNSYLVANIA COUNTIES OBTAIN MORE THAN HALF THEIR TOTAL WATER SUPPLIES FROM GROUNDWATER. BOTH REGIONAL AND LOCAL PROBLEMS OF WATER QUALITY EXIST IN PENNSYLVANIA. MANY OF THESE PROBLEMS ARE THE RESULT OF ACTIVITIES UNDERTAKEN IN THE PAST WITHOUT ADEQUATELY PROTECTING WATER RESOURCES. WATERS THAT FLOW FROM COAL MINES AND CONTAIN HIGH CONCENTRATIONS OF SULFURIC ACID AND IRON IN SOLUTION ARE THE MAJOR PROBLEM OF WATER QUALITY BOTH IN THE VOLUME OF WATER INVOLVED AND THE TOTAL AREA AFFECTED. SECOND TO ACID MINE WATERS IN AREAL EXTENT, BUT EQUALLY SERIOUS, IS THE POLLUTION OF PENNSYLVANIA'S STREAM AND GROUNDWATERS BY SEWAGE AND INDUSTRIAL WASTES. ANOTHER TYPE OF GROUNDWATER POLLUTION IS CAUSED BY CRUDE OIL AND SALINE WATERS MOVING UPWARD INTO FRESH WATER AQUIFERS EITHER THROUGH NATURAL OPENINGS OR THROUGH OIL AND GAS WELLS ABANDONED PRIOR TO THE WELL PLUGGING LAW OF 1951. (WOODARD-USGS)

Stream quality in Appalachia as related to coal-mine drainage, 1965 (Duplicated see Alabama and W. Virginia).
Biesecker, J. E., and George, J. R., 1966

U.S. Geological Survey Circular 526, 27 p

WATER RESOURCES OF THE SCHUYLKILL RIVER BASIN
BIESECKER, J. E.; LESCINSKY, J. B.; WOOD, C. R.
GEOLOGICAL SURVEY, HARRISBURG, PA.
PENN DEP FORESTS AND WATERS, WATER RESOURCES BULL NO 3, MAY 1968. 198 P, 74 FIG, 68 TAB, 95 REF, 1 APPEND.,
Journal Announcement: SWRA0221

THE WATER RESOURCES OF THE SCHUYLKILL RIVER BASIN, PENNSYLVANIA ARE EVALUATED BY A COMPREHENSIVE STUDY OF GROUNDWATER AND SURFACE WATER QUANTITY, QUALITY, AND USE. SPECIAL ATTENTION IS GIVEN TO THE EFFECTS OF COAL MINING, URBANIZATION, AND THE EFFECTS OF RESTORATION AND WATER POLLUTION CONTROL OF THE SCHUYLKILL RIVER. IN MANY PARTS OF THE BASIN, HUMAN ACTIVITIES ARE THE MOST IMPORTANT HYDROLOGIC FACTOR. COAL MINING AFFECTS BOTH GROUNDWATER AND SURFACE WATER QUALITY IN THE HEADWATERS AND AFFECTS THE QUALITY OF THE ENTIRE MAIN STEM OF THE RIVER. RESERVOIR REGULATION AFFECTS THE FLOW OF SEVERAL TRIBUTARIES. PHILADELPHIA DIVERTS UP TO 91% OF THE STREAMFLOW OF THE SCHUYLKILL FOR PUBLIC SUPPLY. PUMPING IS LOWERING GROUNDWATER LEVELS IN MANY AREAS. MEAN ANNUAL RUNOFF IS 21.5 INCHES, OR 48% OF THE ANNUAL PRECIPITATION OF 44.7 INCHES. THE POPULATION OF THE BASIN IS 1.47 MILLION, 91% SERVED BY PUBLIC SUPPLY. THE WATER PROBLEMS OF THE BASIN RESULT MAINLY FROM INADEQUATE MUNICIPAL WATER SYSTEMS AND DEGRADATION OF SOURCES BY POLLUTION. (KNAPP-USGS)

Selected Water Resources Data, Clarion River and Red-Bank Creek Basins, Northwestern Pennsylvania--Part 2
Buckwalter, T. F.; Dodge, C. H.; Schiner, G. R.
Geological Survey, Pittsburgh, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-104915, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-19, July 1979. 135 p, 51 Fig, 8 Tab, 8 Ref.,
Journal Announcement: SWRA1311

This report presents selected basic data collected during a study of the water resources of the Clarion River and Redbank Creek basins in northwestern Pennsylvania. Hydrologic information including data on aquifers, water levels, and yields is presented for 1,304 wells. Records for 51 springs are also given. The report contains 83 chemical analyses of water samples collected from 30 stream sites and 300 analyses of water from 196 wells and 43 springs. Also included are 103 trace-element analyses. Monthly and annual means of ground-water levels for six observation wells are tabulated. Benthic invertebrate data from 136 stream sites are listed. Locations of data-collection sites are shown on 50 page-size reductions of 7.5-minute topographic quadrangle maps. (Kosco-USGS)

Water Resources of the Clarion River and Redbank Creek basins

Buckwalter, T. W., and others, 1981
U.S. Geological Survey Water-Resources Investigations

Chemical quality of surface waters in Pennsylvania
Dorfor, C. N., and Anderson, P. W., 1963
U.S. Geological Survey Water-Supply Paper 1619-W, 50 p.

ACIDITY CONTROL IN BALD EAGLE CREEK AND WEST BRANCH SUSQUEHANNA RIVER, CLINTON COUNTY, PENNSYLVANIA
FLIPPO, H. N. JR
GEOLOGICAL SURVEY, HARRISBURG, PA.
GEOLOGICAL SURVEY OPEN-FILE REPORT, FEBRUARY 1971. 28 P, 8 FIG, 2 REF.,
Journal Announcement: SWRA0501

REGRESSION ANALYSIS OF CHEMICAL AND PHYSICAL DATA COLLECTED ON BEECH CREEK IN CLINTON COUNTY, PENNSYLVANIA IN TWO CURVES THAT RELATE THE CONCENTRATION OF FREE HYDROGEN ION TO THE ELECTRICAL SPECIFIC CONDUCTANCE OF THE WATER. THESE CURVES PROVIDE A MEANS OF ESTIMATING, THROUGH USE OF DATA TELEMETERED FROM A WATER-QUALITY MONITOR ON BEECH CREEK, THE ACID LOAD IN THE STREAM AT ANY TIME. THESE ESTIMATES OF ACID LOADS IN BEECH CREEK ENABLE THE OPERATORS OF FOSTER JOSEPH SAYERS DAM ON BALD EAGLE CREEK TO RELEASE SUFFICIENT ALKALINE WATER FROM THE RESERVOIR TO PREVENT FISH KILLS IN LOWER BALD EAGLE CREEK THAT COULD BE CAUSED BY THE ACID FROM BEECH CREEK. THE ACID CONTENT OF THE WEST BRANCH SUSQUEHANNA RIVER UPSTREAM FROM THE CITY OF LOCK HAVEN USUALLY EXCEEDS THE AMOUNT THAT CAN BE NEUTRALIZED BY BALD EAGLE CREEK. HOWEVER, INASMUCH AS THE ALKALINE CONTENT OF BALD EAGLE CREEK EXCEEDS THE AMOUNT REQUIRED TO EFFECTIVELY NEUTRALIZE THE ACIDITY OF BEECH CREEK, SOME WATER MAY BE CONSERVED IN THE RESERVOIR FOR THE PURPOSE OF IMPROVING THE QUALITY OF THE WEST BRANCH WHEN THE RIVER IS UNUSUALLY ACID. (WOODARD-USGS)

Ground-water resources, Allegheny River basin and part of the Lake Erie basin, New York
Frimpter, M. H., 1974
Allegheny River Basin Regional Water Resources Planning Board Report ARB-2, 98 p.

SUMMARY GROUND-WATER RESOURCES OF ALLEGHENY COUNTY, PENNSYLVANIA
GALLAHER, J. T.
GEOLOGICAL SURVEY, HARRISBURG, PA.

PENNSYLVANIA GEOLOGICAL SURVEY, FOURTH SERIES, WATER RESOURCE REPORT 35, 1973. 71 P, 12 FIG, 1 PLATE, 9 TAB, 12 REF.,

Journal Announcement: SWRA0724

GROUNDWATER IS AVAILABLE IN ALLEGHENY COUNTY, PENNSYLVANIA FROM ROCKS OF MONONGAHELA, CONEMAUGH, AND ALLEGHENY GROUPS, AND FROM UNCONSOLIDATED QUATERNARY DEPOSITS. THE WASHINGTON FORMATION AND THE MONONGAHELA GROUP ARE NOT IMPORTANT AS AQUIFERS. THE CONEMAUGH GROUP CROPS OUT EXTENSIVELY NORTH OF THE OHIO AND ALLEGHENY RIVERS AND CONTAINS SOME OF THE MOST IMPORTANT AQUIFERS IN THE COUNTY: THE CONNELLSVILLE, MORGANTOWN, SALTBURG, BUFFALO AND MAHONING SANDSTONES. THESE FORMATIONS ARE GENERALLY PERSISTENT AND WATERBEARING THROUGHOUT THE COUNTY, AND HAVE YIELDS RANGING FROM 1 OR 2 GPM TO 100 GPM. THE ALLEGHENY GROUP IS FOUND IN THE NORTHEASTERN PART OF THE COUNTRY. WITHIN THIS GROUP, THE MOST IMPORTANT AQUIFERS ARE THE FREEPORT SANDSTONE, WHICH YIELDS 5 TO 75 GPM, AND THE WORTHINGTON SANDSTONE, WHICH GENERALLY YIELDS ENOUGH WATER FOR ALL DOMESTIC NEEDS. WATER SUPPLIES ARE ALSO AVAILABLE FROM THE QUATERNARY ALLUVIUM, WHICH YIELDS FROM 5 TO 3000 GPM, DEPENDING UPON THE DEGREE OF SORTING BY GRAIN SIZE. GROUNDWATER IN THE YOUNGER GEOLOGIC FORMATIONS IS USUALLY LOW IN DISSOLVED SOLIDS, WHILE WATER FROM THE DEEPLY BURIED OLDER FORMATIONS IS HARD AND SOMETIMES HIGH IN CHLORIDES AND IRON. DESPITE HEAVY GROUNDWATER PUMPAGE IN ALLEGHENY COUNTY, THERE ARE RELATIVELY FEW INSTANCES OF OVERDRAFT. USE OF INDUCED INFILTRATION HAS ALLOWED HIGH YIELDS AND RELATIVELY CLOSE SPACING OF WELLS. DISCHARGE FROM ABANDONED STRIP AND DEEP MINES IS A MAJOR SOURCE OF POLLUTION. THE HUNDREDS OF OIL AND GAS WELLS THAT WERE DRILLED IN THE COUNTY ARE ANOTHER SOURCE. (KNAPP-USGS)

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Sediment Discharge from Highway Construction Near Port Carbon, Pennsylvania

Helm, R. E.

Geological Survey, Harrisburg, PA. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 793, Price codes: A13 in paper copy, A01 in microfiche. Water-Resources Investigations 78-35, April 1978. 27 p, 19 fig, 6 ref.,

Journal Announcement: SWRA1120

The effects of highway construction on suspended-sediment loads were studied in the upper reaches of the Schuylkill River basin, Schuylkill County, Pennsylvania, from April 1975 to March 1977. From March 1975 to October 1976, 4.3 miles of State Route 209 was relocated through the upper reaches of the basin, a mountainous watershed with a drainage area of 27.1 square miles. About 16,000 tons of suspended-sediment was discharged from the basin during the construction. The highway construction produced about 8,000 tons or 50 percent of the total sediment discharge. Steep slopes, the availability of fine coal wastes, coal-washing operations, and other land uses in the basin were responsible for most of the remaining sediment discharge. Seventy percent of the total suspended-sediment discharge occurred during eight storms. (Woodard-USGS)

Hydrology of Area 3, Eastern Coal Province, Pennsylvania
Herb, W. J.; Shaw, L. C.; Brown, D. E.
Geological Survey, Harrisburg, PA. Water Resources Div.
Geological Survey Open-File Report 81-537 (WRI), September 1981. 88 p, 65 Fig, 26 Tab, 29 Ref, Append.,
Journal Announcement: SWRA1511

Hydrologic data are presented for area 3 of the Eastern Coal Province, 4,077 square miles of the lower Allegheny River basin in western Pennsylvania. Seventy-three streams were sampled three times during the 1979 and 1980 water years for specific conductance, pH, acidity, alkalinity, dissolved and total iron, dissolved and total manganese, dissolved sulfate, and dissolved solids. Benthic invertebrate populations were determined and botom material samples were analyzed for metals. Sixteen streams had pH, acidity, alkalinity, total iron, total manganese, and dissolved sulfate indicative of acid-mine drainage. These streams were most common in the Redbank and Blacklick Creek basins and in the Conemaugh and lower Kiskiminetas River basins. Benthic invertebrates were not found in 11 of 64 streams sampled. An additional 13 streams had low benthic invertebrate diversity indices. Low diversity indices were most common in the southern part of area 3. Low flow, mean flow, peak flow, and flow duration data are presented for gaging stations in area 3. Techniques for estimating these data for ungaged sites are presented and referenced. The functions of, and access to, the National Water Data Exchange, National Water Data Storage and Retrieval System, and Office of Water Data Coordination are explained. (USGS)

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia
Herb, W. J.; Shaw, L. C.; Brown, D. E.
Geological Survey, Harrisburg, PA. Water Resources Div.
Geological Survey Open-File Report 81-538 (WRI), September 1981. 92 p, 60 Fig, 22 Tab, 37 Ref, Append.,
Journal Announcement: SWRA1511

Hydrologic data are presented for area 5 of the Eastern Coal Province, the 7,384 square-mile Monongahela River basin in western Pennsylvania, western Maryland, and north-central West Virginia. One hundred thirty-four streams were sampled about three times during the 1979 and 1980 water years for specific conductance, pH, acidity, alkalinity dissolved and total iron, dissolved and total manganese, dissolved sulfate, and dissolved solids. Benthic invertebrate populations were determined and bottom material samples were analyzed for metals. Eleven streams had pH, acidity, alkalinity, total iron, total manganese, and dissolved-sulfate levels indicative of acid-mine drainage. These streams were most common in the Tygart Valley River basin, although indicators of acid-mine drainage were found throughout the Monongahela basin. No benthic invertebrates were found in 25 of 129 streams sampled. Such streams were most common in the Cheat and Tygart Valley River basins. Low flow, mean flow, peak flow, and flow duration data are presented for gaging stations in area 5. Techniques for estimating these data for ungaged sites are presented and referenced. The functions of, and access to, the National Water Data Exchange, WATSTORE, and indexes to water-data activities in coal provinces are presented. (USGS)

HYDROLOGY OF THE PLEISTOCENE SEDIMENTS IN THE WYOMING VALLEY, LUZERNE COUNTY, PENNSYLVANIA
HOLLOWELL, J. R.
GEOLOGICAL SURVEY, HARRISBURG, PA.
PENNSYLVANIA GEOLOGICAL SURVEY WATER RESOURCE REPORT 28, 4TH SERIES, 1971. 77 P, 16 FIG, 4 PLATE, 7 TAB, 27 REF, APPEND.,
Journal Announcement: SWRA0505

THICK ACCUMULATIONS OF GLACIAL TILL, OUTWASH DEPOSITS, AND LAKE DEPOSITS UNDERLIE THE WYOMING VALLEY IN LUZERNE COUNTY, PENN. OUTWASH DEPOSITS OF SAND AND GRAVEL OVERLYING THE LAKE DEPOSITS YIELD AS MUCH AS 1,200 GPM. THE GLACIAL DEPOSITS BENEATH THE VALLEY FLOOD PLAIN CONSTITUTE THE MOST IMPORTANT AQUIFER IN THE WYOMING VALLEY. THE AQUIFER IS USED ONLY FOR IRRIGATION AT PRESENT. RECHARGE TO THE AQUIFER, MAINLY FROM PRECIPITATION, IS ESTIMATED TO BE 15 INCHES PER YEAR. NATURAL DISCHARGE FROM THE GLACIAL DEPOSITS IS MAINLY BY SEEPAGE INTO THE STREAMS. OVER 1 BILLION GPD OF GROUNDWATER PROBABLY COULD BE OBTAINED BY PUMPING WELLS PLACED NEAR THE RIVER AND INDUCING WATER INTO THE AQUIFER FROM THE SUSQUEHANNA RIVER. THE INFILITRATION WATER WOULD HAVE A RELATIVELY CONSTANT TEMPERATURE, QUALITY, AND QUANTITY ADEQUATE FOR MUNICIPAL OR INDUSTRIAL USE. THE GROUNDWATER IN THE GLACIAL DEPOSITS IS PREDOMINANTLY OF THE CALCIUM BICARBONATE-SULFATE TYPE, HIGH IN DISSOLVED SOLIDS, AND HARD. LOCALLY, THE QUALITY IS AFFECTED ADVERSELY BY SURFACE DEPOSITS OF MINE WASTE WHICH CONTRIBUTE LARGE QUANTITIES OF LEACHED CALCIUM, IRON, AND SULFATE IONS TO THE GROUNDWATER. (WOODARD-USGS)

Hydrology of the abandoned coal mines in the Wyoming Valley, Pennsylvania
Hollowell, J. R., 1974
Open-File Report 74-237, 1974. 47 p. 6 fig, 3 tabs, 5 ref, Append. 75-02128.

GROUND-WATER RESOURCES OF LACKAWANNA COUNTY, PENNSYLVANIA
HOLLOWELL, J. R.; KOESTER, H. E.
SUSQUEHANNA RIVER BASIN COMMISSION, HARRISBURG, PA.; AND PENNSYLVANIA STATE GEOLOGICAL SURVEY, HARRISBURG.
PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES,

HARRISBURG WATER RESOURCES REPORT 41, 1975. 106 P, 26 FIG, 3 PLATE, 20 TAB, 28 REF.,

Journal Announcement: SWRA0905

LACKAWANNA COUNTY COMPRISES AN AREA OF ABOUT 450 SQ MI IN NORTHEASTERN PENNSYLVANIA. THE COUNTY IS BISECTED BY THE LAKAWANNA VALLEY, PART OF A STRUCTURAL BASIN CONTAINING THE NORTHERN ANTHRACITE FIELD. SINCE 1960, SUBURBAN DEVELOPMENT HAS CREATED A DEMAND FOR GROUNDWATER SUPPLIES. THE PRINCIPAL AQUIFER IS THE CATSKILL FORMATION. OTHER AQUIFERS ARE UTILIZED, BUT, BECAUSE OF THEIR SMALL AREAL EXTENT, THEY ARE RELATIVELY UNIMPORTANT. GROUNDWATER OCCURS MAINLY IN BEDDING PLANES, JOINTS, FAULTS, AND OTHER FRACTURES IN THE ROCKS. WELLS DRILLED INTO THE FRACTURED ROCK AQUIFER HAVE YIELDS THAT RANGE FROM A HALF GALLON TO 300 GPM. WELLS DRILLED IN VALLEYS HAVE A MEDIAN YIELD OF 50 GPM, WHICH IS ABOUT 40 TIMES THAT OF HILLTOP AND HILLSIDE WELLS. WATER FROM MOST WELLS TAPPING THE CATSKILL FORMATION IS OF GOOD QUALITY. IT IS LOW IN DISSOLVED SOLIDS AND IS PRIMARILY A BICARBONATE-TYPE WATER. MINE DRAINAGE ENTERS THE LACKAWANNA RIVER AT NUMEROUS POINTS ALONG ITS COURSE IN LACKAWANNA COUNTY. DISSOLVED-SOLIDS

Ground-Water Quality and Data on Wells and Springs in Pennsylvania, Volume II--Susquehanna and Potomac River Basins

Koester, H. E.; Miller, D. R.

Geological Survey, Harrisburg, PA. Water Resources Div.

Available from OFSS, USGS. Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $17.25, Microfiche $3.50. Geological Survey Open-File Report 81-329, March, 1982. 131 p, 16 Fig, 16 Tab, 2 Ref.,

Journal Announcement: SWRA1604

Volume II of the Ground-Water Quality and Data on Wells and Springs in Pennsylvania presents ground-water quality and physical data on about 1,400 wells and springs in the Susquehanna and Potomac River basins in Pennsylvania. Locations are shown on site-location maps derived from the hydrologic unit map. Codes showing the geologic age and aquifer are provided. (USGS)

Ground-Water Quality and Data on Wells and Springs in Pennsylvania, Volume III--Delaware River Basin

Koester, H. E.; Miller, D. R.

Geological Survey, Harrisburg, PA. Water Resources Div.

OFSS USGS. Box 25425 Fed. Ctr. Denver, CO 80225. Paper copy $14.75, Microfiche $3.50. Geological Survey Open-File Report 81-330, March, 1982. 111 p, 9 Fig, 9 Tab, 2 Ref.,

Journal Announcement: SWRA1604

Volume III of the Ground-Water Quality and Data on Wells and Springs in Pennsylvania presents ground-water quality and physical data on about 1,250 wells and springs in the Delaware River basin in Pennsylvania. Locations are shown on site-location maps derived from the hydrologic unit map. Codes showing the geologic age and aquifer are provided. (USGS)

Ground-Water Quality and Data on Wells and Springs in Pennsylvania, Volume I--Ohio and St. Lawrence River Basins
Koester, H. E.; Miller, D. R.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $12.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-1119, November 1980. 95 p, 15 Fig, 15 Tab, 2 Ref.,
Journal Announcement: SWRA1414
Volume I of the Groundwater Quality and Data on Wells and Springs in Pennsylvania presents groundwater quality and physical data on about 1,200 well and spring sites in the Ohio and St. Lawrence River basins. Locations are shown on site-location maps derived from the hydrologic unit map. Codes showing the geologic age and aquifer are provided. (USGS)

WATER QUALITY AND DISCHARGE OF STREAMS IN THE LEHIGH RIVER BASIN, PENNSYLVANIA
MCCARREN, EDWARD F.; KEIGHTON, WALTER B.
GEOLOGICAL SURVEY, WASHINGTON, D.C. DC, 20402 -- PRICE $0.35. GEOL SURV WATER-SUPPLY PAP 1879-H, P H1-H48, 1969. 48 P, 11 FIG, 6 TAB, 12 REF.,
Journal Announcement: SWRA0306
THE LEHIGH RIVER, 100 MILES LONG, IS THE SECOND LARGEST TRIBUTARY TO THE DELAWARE RIVER. IT DRAINS 1,364 SQ MI IN 4 PHYSIOGRAPHIC PROVINCES. THE LEHIGH RIVER BASIN INCLUDES MOUNTAINOUS AND FORESTED AREAS, BROAD AGRICULTURAL VALLEYS AND AREAS OF URBAN AND INDUSTRIAL DEVELOPMENT. IN THE HEADWATERS THE WATER IS OF GOOD QUALITY AND HAS A LOW CONCENTRATION OF SOLUTES. DOWNSTREAM, SOME TRIBUTARIES RECEIVE COAL-MINE DRAINAGE AND BECOME ACIDIC; OTHERS DRAIN AREAS UNDERLAIN BY LIMESTONE AND ACQUIRE ALKALINE CHARACTERISTICS. THE ALKALINE STREAMS NEUTRALIZE AND DILUTE THE ACID MINE WATER WHERE THEY MIX. THE DISSOLVED-OXYGEN CONTENT OF RIVER WATER, WHICH IS HIGH IN THE UPPER REACHES OF THE STREAM, IS REDUCED IN THE LOWER REACHES BECAUSE OF LOWER TURBULENCE, HIGHER TEMPERATURE, AND THE RESPIRATION OF ORGANISMS. MOST OF THE RIVER WATER REQUIRES ONLY MODERATE TREATMENT FOR INDUSTRIAL USE AND PUBLIC DISTRIBUTION THROUGHOUT THE LEHIGH RIVER VALLEY. AT TIMES, HOWEVER, SOME SEGMENTS OF THE MAIN RIVER AND ITS TRIBUTARIES TRANSPORT INDUSTRIAL WASTES AND ACID COAL-MINE DRAINAGE. SINCE MAY 1966 AN INSTRUMENT INSTALLED BY THE U.S. GEOLOGICAL SURVEY AT EASTON, PA., HAS CONDUCTANCE, TEMPERATURE, AND DISSOLVED OXYGEN CONTENT. STREAMFLOW AND WATER QUALITY DATA ARE TABULATED. (KNAPP-USGS)

SUMMARY GROUND-WATER RESOURCES OF CLARION COUNTY, PENNSYLVANIA
NEWPORT, T. G.

GEOLOGICAL SURVEY, HARRISBURG, PA. WATER RESOURCES DIV.
PENNSYLVANIA GEOLOGICAL SURVEY BULLETIN W32, 1973. 42 P, 6 FIG, 1 PLATE, 7 TAB, 9 REF.,
Journal Announcement: SWRA0704

THE GEOLOGIC FORMATIONS IN CLARION COUNTY, PENNSYLVANIA, RANGE FROM THE MISSISSIPPIAN POCONO GROUP TO QUATERNARY ALLUVIUM ALONG SOME OF THE MAJOR STREAMS. DATA FROM MORE THAN 70 WELLS DRILLED IN THE COUNTY INDICATE THAT THE HIGHEST GROUNDWATER YIELDS ARE OBTAINED FROM AQUIFERS IN THE POCONO GROUP AND IN THE ALLUVIUM DEPOSITS. WATER IN THE SANDSTONE AND LIMESTONE AQUIFERS OF THE CONSOLIDATED ROCKS OCCURS IN PORE SPACES AND IN SECONDARY OPENINGS SUCH AS FRACTURES AND SOLUTION CHANNELS. YIELDS FROM SANDSTONE IN THE POCONO GROUP VARY WIDELY, DEPENDING ON THE AMOUNT OF SHALE INTERBEDDED. YIELDS OF LESS THAN 50 GPM TO OVER 500 GPM HAVE BEEN REPORTED. IN THE POTTSVILLE GROUP, THE AVERAGE YIELD IS 28 GPM, BUT IF THE WELLS PENETRATE BOTH THE UPPER AND LOWER SANDSTONE MEMBERS, THE YIELD MAY BE MUCH HIGHER. THE SANDSTONE AND LIMESTONE MEMBERS OF THE ALLEGHENY GROUP ARE RELIABLE SOURCES OF SMALL TO MODERATE AMOUNTS OF GROUNDWATER AND WILL YIELD ADEQUATE AMOUNTS FOR DOMESTIC USE AT ALMOST ANY LOCATION DRILLED. EXCESSIVE IRON IS THE MAIN WATER QUALITY PROBLEM IN GROUNDWATER OF CLARION COUNTY. GROUNDWATER IN THE DEEPER AQUIFERS IS GENERALLY HIGHLY MINERALIZED. IN SOME (WOODWARD-USGS)

Summary Ground-Water Resources of Luzerne County, Pennsylvania
Newport, T. G.
Geological Survey, Harrisburg, PA. Water Resources Div. Resources Report 40, 1977. 63 p, 10 fig, 1 plate, 5 tab, 21 ref.,
Journal Announcement: SWRA1101

The geologic units in Luzerne County, Pa., include the unconsolidated Quaternary deposits; the Pennsylvania Llewellyn and Pottsville Formations; the Mississippian Mauch Chunk and Pocono Formations; and the Devonian Catskill Formation, marine beds, and Hamilton Group. Ground water occurs largely in the pore spaces, secondary openings, and solution channels in the consolidated rocks. In the alluvium deposits along the Susquehanna River, yields of over 1,000 gpm have been reported from wells. The Llewellyn Formation, marine beds, and Hamilton Group are the poorest of the bedrock aquifers. Well yields range from less than 1 to 50 gpm and water is of poor quality. In the other bedrock aquifers, well yields range from 2 to 325 gpm, and most wells produce soft water of good quality. Well-water samples collected outside of the mined areas were of acceptable quality. Ground water in the vicinity of the coal mines is generaly high in iron and sulfate. There is no known overdraft of ground water anywhere in the county, except in the vicinity of active mines, where the water table is being lowered to facilitate mining. The locations of sources of pollution, such as sanitary landfills and septic tanks, are a major factor in the selection of well sites. The discharge from abandoned strip and deep mines is a major source of pollution. (Woodard-USGS)

SUMMARY GROUND-WATER RESOURCES OF WASHINGTON COUNTY, PENNSYLVANIA

NEWPORT, T. G.

GEOLOGICAL SURVEY, HARRISBURG, PA.

PENNSYLVANIA GEOLOGICAL SURVEY, FOURTH SERIES, WATER RESOURCE REPORT 38, 1973. 32 P, 5 FIG, 6 TAB, 12 REF.,

Journal Announcement: SWRA0724

GROUNDWATER IS AVAILABLE IN WASHINGTON COUNTY, PENNSYLVANIA, FROM ROCKS OF THE PENNSYLVANIAN MONONGAHELA AND CONEMAUGH GROUPS, THE PERMIAN-PENNSYLVANIAN WASHINGTON FORMATION, THE PERMIAN GREENE FORMATION, AND FROM UNCONSOLIDATED QUATERNARY DEPOSITS. THE ALLUVIUM IS GENERALLY PERMEABLE AND, WHEN SATURATED, WILL YIELD MODERATE TO LARGE SUPPLIES OF WATER, DEPENDING UPON THE DEGREE OF SORTING BY GRAIN SIZE. GROUNDWATER IN A BEDROCK OCCURS LARGELY IN SECONDARY OPENINGS, SUCH AS JOINT PLANES OR SOLUTION OPENINGS. THE GREENE FORMATION AND THE MONONGAHELA GROUP ARE POOR WATERBEARERS BECAUSE OF THE SMALLNESS AND SCARCITY OF FRACTURES. THE WASHINGTON FORMATION CROPS OUT EXTENSIVELY IN THE COUNTY, BUT IS ALSO A POOR WATERBEARER. THE CONEMAUGH GROUP CROPS OUT IN THE EXTREME NORTHERN PART OF THE COUNTY AND ALONG SOME STREAM VALLEYS IN OTHER PARTS OF THE COUNTY. THIS GROUP IS A SOURCE OF SMALL TO MODERATE SUPPLIES OF WATER; THE MEDIAN YIELD IS 5 GPM. EXTREMES IN QUALITY ARE DUE TO BOTH MANMADE AND NATURAL CAUSES. THE MOST COMMON UNDESIRABLE CONSTITUENT OF THE GROUNDWATER IS IRON. WATER DRILLED IN AQUIFERS TOO FAR BELOW THE LEVEL OF THE MAJOR DRAINAGE SYSTEMS SHOWS EXCESSIVE MINERALIZATION. THERE IS NO KNOWN OVERDRAFT OF WATER IN WASHINGTON COUNTY. THE GREATEST WATER PROBLEM IN THE COUNTY IS POLLUTION OF THE WATER RESOURCES BY DRAINAGE FROM COAL-MINING OPERATIONS. OIL AND GAS WELLS THAT WERE ABANDONED BUT NOT PROPERLY PLUGGED ARE ANOTHER SOURCE OF GROUNDWATER POLLUTION. (KNAPP-USGS)

SUMMARY GROUND-WATER RESOURCES OF WESTMORELAND COUNTY, PENNSYLVANIA

NEWPORT, T. G.

GEOLOGICAL SURVEY, HARRISBURG, PA.

PENNSYLVANIA GEOLOGICAL SURVEY, FOURTH SERIES, WATER RESOURCE REPORT 37, 1973. 49 P, 9 FIG, 1 PLATE, 6 TAB, 12 REF.,

Journal Announcement: SWRA0724

GROUNDWATER IS AVAILABLE IN WESTMORELAND COUNTY, PENNSYLVANIA, FROM ROCKS RANGING IN AGE FROM THE MISSISSIPPIAN POCONO GROUP TO QUATERNARY ALLUVIUM. THE ALLUVIUM OVERLIES BEDROCK IN THE MAJOR STREAM VALLEYS IN THE COUNTY. THE YIELDS OF WELLS DRILLED FROM 15 TO 85 FEET IN THE ALLUVIUM RANGE FROM 15 TO 700 GPM AND AVERAGE 230 GPM. OF THE CONSOLIDATED AQUIFERS, THE PENNSYLVANIAN CONEMAUGH AND ALLEGHENY GROUPS YIELD SMALL TO MODERATE SUPPLIES OF WATER. THE POTTSVILLE GROUP HAS YIELDS OF 20 TO 500 GPM, DEPENDING ON WHETHER THE WELLS

PENETRATE THE FULL THICKNESS OF THE SANDSTONE. THE MISSISSIPPIAN POCONO GROUP IS DEEPLY BURIED THROUGHOUT MOST OF THE COUNTY, BUT IN ITS OUTCROP AREAS THERE ARE MANY HILLSIDE SPRINGS WHICH YIELD 5 TO 100 GPM. MANY SAMPLES ARE HIGH IN IRON CONTENT. IN THE WESTERN PART OF THE COUNTY, SALTWATER IS A PROBLEM IN ANY WELL DEEPER THAN 50 TO 100 FEET. THE AMOUNT OF GROUNDWATER USED FOR MOST PURPOSES HAS PROBABLY DECREASED DUE TO IMPROVED PLANT DESIGN AND TO THE USE OF MORE EFFICIENT MANUFACTURING TECHNIQUES. SINCE THERE IS RELATIVELY LITTLE USE OF GROUNDWATER IN THE COUNTY, THERE IS NO KNOWN OVERDRAFT. THE GREATEST WATER PROBLEM IN THE COUNTY IS THE CONTAMINATION OF WATER RESOURCES BY DRAINAGE FROM COAL-MINING OPERATIONS. OTHER SOURCES OF POLLUTION ARE THE NUMEROUS OIL AND GAS WELLS THAT WERE ABANDONED BUT NOT PROPERLY PLUGGED. (KNAPP-USGS)

WATER RESOURCES INVESTIGATIONS IN THE SUSQUEHANNA RIVER BASIN
PAGE, L. V.; SEABER, P. R.
GEOLOGICAL SURVEY, HARRISBURG, PA.
PENNSYLVANIA DEPARTMENT OF FORESTS AND WATERS TECHNICAL BULLETIN NO 2, 1970. 1 SHEET, 2 TAB, 1 MAP.,
Journal Announcement: SWRA0402

ACTIVE AREAL PROJECTS IN THE SUSQUEHANNA RIVER BASIN OPERATED BY THE U.S. GEOLOGICAL SURVEY (WRD) IN COOPERATION WITH OTHER AGENCIES ARE SHOWN ON THIS HYDROLOGIC ATLAS AS FOLLOWS: (A) HYDROLOGY AND SEDIMENTATION OF THE COREY CREEK AND ELK RUN WATERSHEDS; (B) SURFACE-WATER QUALITY OF THE WEST BRANCH SUSQUEHANNA RIVER BASIN; (C) ACIDITY OF BEECH CREEK; (D) SURFACE-WATER QUALITY OF THE WEST BRANCH SUSQUEHANNA BASIN IN THE VICINITY DANVILLE, PA.; (F)HYDROLOGY AND SEDIMENTATION OF THE BIXLER RUN WATERSHED; (G) WATER RESOURCES OF THE SWATARA CREEK BASIN; (H) GEOLOGY AND HYDROLOGY OF THE MARTINSBURG SHALE IN CENTRAL DAUPHIN COUNTY, PA.; (I) VARIATIONS IN THE CHEMICAL CHARACTER OF THE SUSQUEHANNA RIVER AT HARRISBURG, PA.; (J) HYDROLOGY OF LIMESTONES IN THE LEBANON VALLEY; (K) HYDROLOGY OF THE NEW OXFORD FORMATION IN ADAMS AND YORK COUNTIES, PA.; (L) HYDROLOGY OF THE NEW OXFORD FORMATION IN LANCASTER COUNTY, PA.; (M) HYDROLOGY OF THE CARBONATE ROCKS OF THE LANCASTER QUADRANGLE, LANCASTER COUNTY, PA.; (N) HYDROLOGY OF THE METAMORPHIC AND IGNEOUS ROCKS OF CENTRAL CHESTER COUNTY, PA.; AND (O) RECONNAISSANCE OF THE CHEMICAL QUALITY OF MARYLAND STREAMS. LISTED ARE 150 SELECTED REPORTS DEVOTED EXCLUSIVELY TO OR CONTAINING DATA ON WATER IN THE SUSQUEHANNA RIVER BASIN. (WOODARD-USGS)

SUMMARY GROUND-WATER RESOURCES OF ARMSTRONG COUNTY, PENNSYLVANIA
POTH, C. W.
GEOLOGICAL SURVEY, HARRISBURG, PA.
PENNSYLVANIA GEOLOGICAL SURVEY, FOURTH SERIES, WATER RESOURCES REPORT 34, 1973. 38 P, 6 FIG, 1 PLATE, 7 TAB, 27 REF.,

Journal Announcement: SWRA0724

GROUNDWATER OCCURS IN ARMSTRONG COUNTY, PENNSYLVANIA IN UNCONSOLIDATED DEPOSITS ALONG THE STREAM VALLEYS, ESPECIALLY THE ALLEGHENY RIVER, AND IN FRACTURES IN THE BEDROCK. YIELDS OF WELLS IN THE UNCONSOLIDATED DEPOSITS AVERAGE ABOUT 400 GPM AND YIELDS AS HIGH AS 1,100 GPM HAVE BEEN REPORTED. WELLS DRILLED INTO THE BEDROCK YIELD CONSIDERABLY LESS WATER THAN THOSE IN THE UNCONSOLIDATED MATERIAL. THE AVERAGE YIELD OF WELLS IN THE BEDROCK IS ABOUT 25 GPM, ALTHOUGH SOME WELLS YIELD LESS THAN 1 GPM AND SOME AS MUCH AS 350 GPM. THE WATER IS GENERALLY HARD AND HIGH IN CALCIUM, MAGNESIUM, SULFATE, AND IRON. WATER FROM DEEPLY BURIED ROCKS IS ALSO HIGH IN CHLORIDE. THERE IS NO KNOWN OVERDRAFT OF GROUNDWATER, BUT OVERDRAFT IS POSSIBLE IN THE FUTURE. THE LOCATIONS OF SOURCES OF POLLUTION, SUCH AS SANITARY LANDFILLS AND SEPTIC TANKS, ARE A MAJOR FACTOR IN THE SELECTION OF WELL SITES. THE CHIEF WATER PROBLEM IS CONTAMINATION BY DRAINAGE FROM COAL-MINING OPERATIONS. OTHER SOURCES OF CONTAMINATION ARE THE HUNDREDS OF OIL AND GAS WELLS THAT WERE ABANDONED BUT NOT PROPERLY PLUGGED. THE CASINGS HAVE BEEN REMOVED OR ARE SEVERELY CORRODED, ALLOWING SALTWATER TO RISE IN THE BOREHOLES AND CONTAMINATE SHALLOW FRESHWATER AQUIFERS. (KNAPP-USGS)

SUMMARY GROUND-WATER RESOURCES OF BEAVER COUNTY, PENNSYLVANIA
POTH, C. W.
GEOLOGICAL SURVEY, HARRISBURG, PA.
PENNSYLVANIA GEOLOGICAL SURVEY, FOURTH SERIES, WATER RESOURCE REPORT 39, 1973. 39 P, 4 FIG, 1 PLATE, 7 TAB, 22 REF.,
Journal Announcement: SWRA0724

GROUNDWATER IS AVAILABLE IN BEAVER COUNTY, PENNSYLVANIA, FROM ROCKS OF THE PENNSYLVANIAN MONONGAHELA, CONEMAUGH, ALLEGHENY, AND POTTSVILLE GROUPS AND FROM UNCONSOLIDATED QUATERNARY DEPOSITS. GROUNDWATER OCCURS LARGELY IN THE UNCONSOLIDATED QUATERNARY ALLUVIAL DEPOSITS THAT ARE PRESENT AS TERRACES AND MODERN FLOOD PLAINS ALONG THE MAJOR STREAMS OF THE COUNTY. YIELDS OF OVER 1000 GPM HAVE BEEN REPORTED FROM WELLS DRILLED IN THESE ALLUVIAL DEPOSITS. SMALL SUPPLIES OF WATER ARE ALSO AVAILABLE IN THE BEDROCK, BUT THE WATER IS GENERALLY OF POOR QUALITY. MOST OF THE WATER IS OF ACCEPTABLE QUALITY. THE WATER IS GENERALLY HIGH IN IRON, AND MUCH OF THE BEDROCK BELOW SEVERAL HUNDRED FEET MAY CONTAIN SALTWATER. THERE IS NO KNOWN OVERDRAFT OF GROUNDWATER ANYWHERE IN THE COUNTY. THE LOCATIONS OF SOURCES OF POLLUTION, SUCH AS SANITARY LANDFILLS AND SEPTIC TANKS, ARE A MAJOR FACTOR IN THE SELECTION OF WELL SITES. THE DISCHARGE FROM ABANDONED STRIP AND DEEP MINES IS A MAJOR SOURCE OF POLLUTION. OIL AND GAS WELLS THAT WERE ABANDONED AND NOT PROPERLY PLUGGED ARE ANOTHER SOURCE OF POLLUTION. (KNAPP-USGS)

SUMMARY GROUND-WATER RESOURCES OF BUTLER COUNTY, PENNSYLVANIA
POTH, C. W.
GEOLOGICAL SURVEY, HARRISBURG, PA.

PENNSYLVANIA GEOLOGICAL SURVEY, FOURTH SERIES, WATER RESOURCES REPORT 36, 1973. 49 P, 4 FIG, 1 PLATE, 7 TAB, 27 REF.,

Journal Announcement: SWRA0724

GROUNDWATER IS AVAILABLE IN BUTLER COUNTY, PENNSYLVANIA FROM ROCKS OF THE MISSISSIPPIAN POCONO GROUP, THE PENNSYLVANIAN CONEMAUGH, ALLEGHENY, AND POTTSVILLE GROUPS, AND FROM UNCONSOLIDATED QUATERNARY DEPOSITS. THE QUATERNARY OUTWASH DEPOSITS AND SOME OF THE QUATERNARY LACUSTRINE DEPOSITS ARE HIGHLY PERMEABLE AND ARE CAPABLE OF YIELDING 100 GPM OR MORE TO WELLS. ROCKS OF THE CONEMAUGH GROUP UNDERLIE ABOUT TWO-THIRDS OF THE COUNTY. REPORTED YIELDS OF WELLS IN THE CONEMAUCH RANGE FROM LESS THAN 5 GPM TO MORE THAN 100 GPM; ABOUT HALF OF THE WELLS YIELD 20 GPM OR MORE. THE ALLEGHENY GROUP CROPS OUT IN THE NORTHERN HALF OF THE COUNTY AND ALONG THE MAJOR STREAM VALLEYS THROUGHOUT THE COUNTY. THIS GROUP IS CAPABLE OF SUPPLYING MODERATE AMOUNTS OF WATER TO WELLS. YIELDS RANGE FROM LESS THAN 5 GPM TO MORE THAN 100 GPM, AND ABOUT HALF THE WELLS YIELD 50 GPM OR MORE. THE POTTSVILLE GROUP CROPS OUT ALONG THE MAJOR STREAM VALLEYS IN THE NORTHERN PART OF THE COUNTY. YIELDS OF WELLS IN THE POTTSVILLE RANGE FROM LESS THAN 5 GPM TO MORE THAN 300 GPM, AND AVERAGE 36 GPM. THE BURGOON SANDSTONE OF THE POCONO GROUP OCCURS IN THE NORTHEASTERN PART OF THE COUNTY ALONG THE ALLEGHENY RIVER AND THE LOWER REACHES OF BEAR CREEK. IT IS AN EXCELLENT AQUIFER; REPORTED YEILDS RANGE FROM 9 TO 260 GPM AND AVERAGE 82 GPM. HIGH IRON CONTENT IS THE MAIN WATER QUALITY PROBLEM IN THE COUNTY. THERE IS NO KNOWN OVERDRAFT OF GROUNDWATER. THE LOCATIONS OF SOURCES OF POLLUTION, SUCH AS SANITARY LANDFILLS AND SEPTIC TANKS, ARE A MAJOR FACTOR IN THE SELECTION OF WELL SITES. THE DISCHARGE FROM ABANDONED STRIP AND DEEP MINES IS A MAJOR SOURCE OF POLLUTION. OIL AND GAS WELLS THAT WERE ABANDONED AND NOT PROPERLY PLUGGED ARE ANOTHER SOURCE OF POLLUTION. (KNAPP-USGS)

Effects of Strip Mining the Abandoned Deep Anna S Mine on the Hydrology of Babb Creek, Tioga County, Pennsylvania

Reed, L. A.

Geological Survey, Harrisburg, PA. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-121337, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-53, August, 1980. 41 p, 16 Fig, 13 Tab, 8 Ref.,

Journal Announcement: SWRA1413

Daylighting (strip mining of coal seams previously deep mined) operations are being conducted on the Anna S Mine, that underlies about 850 acres that are drained by three major discharges. The Hunter Drift drains an underground area of about 400 acres, the Anna S 1 main entry, an area of 330 acres, and Mitchel 2 discharge an area of about 120 acres. As of August 1, 1979, about 55 acres (15%) had been daylighted in the Hunter Drift basin, about 15 acres (5%) in the Anna S main entry basin and about 30 acres (25%) in the Mitchel basin. The acidity of the Mitchel 2 discharge changed the most, from 176 milligrams per liter (as CaCO3) in 1975-76 to 1,190 in 1978-79, an increase of 580%. The acidity of the Hunter Drift discharge increased from 348 milligrams per liter during 1975-76 to 710 milligrams per liter during 1978-79, an increase of 100%. The acidity of Anna S 1 increased about 45%. (USGS)

WATER RESOURCES INVESTIGATIONS IN THE UPPER OHIO RIVER BASIN
ROSSOW, C. J.; COLL, M. B. JR
GEOLOGICAL SURVEY, HARRISBURG, PA.
PENNSYLVANIA DEPARTMENT OF FORESTS AND WATERS TECHNICAL BULLETIN NO 1, 1970. 1 SHEET, 2 TAB, 1 MAP.,
Journal Announcement: SWRA0402

ACTIVE AREAL PROJECTS IN THE UPPER OHIO RIVER BASIN OPERATED BY THE U. S. GEOLOGICAL SURVEY (WRD) LARGELY IN COOPERATION WITH OTHER AGENCIES, ARE SHOWN ON THIS HYDROLOGIC ATLAS AS FOLLOWS: (A) GROUND-WATER RESOURCES, ALLEGHENY RIVER BASIN AND PART OF THE LAKE ERIE BASIN, NEW YORK; (B) SURFACE-WATER RESOURCES OF THE ALLEGHENY RIVER BASIN AND PART OF THE LAKE ERIE BASIN, NEW YORK; (C) CHEMICAL QUALITY OF STREAMS, ALLEGHENY RIVER BASIN, NEW YORK; (D) GEOLOGY AND GROUND-WATER RESOURCES OF WESTERN CRAWFORD COUNTY; (E) GEOLOGY AND GROUND-WATER RESOURCES OF THE SHENANGO AND STONEBORO QUADRANGLES; (F) INVESTIGATION OF PRINCIPAL AQUIFERS IN NORTHEASTERN OHIO; AND (G) ROARING CREEK-GRASSY RUN ACID MINE DRAINAGE INVESTIGATIONS OR CONTAINING DATA ON WATER IN THE OHIO RIVER BASIN AND 45 SELECTED REFERENCES ON HYDROLOGY. (WOODARD-USGS)

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia
Roth, D. K.; Engelke, M. J. Jr
Geological Survey, Columbus, OH. Water Resources Div.
Geological Survey Open-File Report 81-343 (WRI), July, 1981. 62 p, 41 Ref, 3 Append.,
Journal Announcement: SWRA1511

Area 4 (one of the 24 hydrologic areas defining the Eastern Coal Province) is located at the northern end of the Eastern Coal Province in eastern Ohio, northern West Virginia, and western Pennsylvania. It is part of the upper Ohio River basin, which includes the Beaver, Mahoning, and Shenango Rivers. The area is underlain by rocks of the Pottsville, Allegheny, Conemaugh, Monongahela Groups (or Formations) and Dunkard Group. Area 4 has a temperate climate with an annual average rainfall of 38 to 42 inches, most of its area is covered by forest. The soils have a high erosion potential where the vegetation cover is removed. In response to Public Law 95-87, 132 sites were added to the existing surface-water data-collection network in area 4. At these added sites, collected data includes discharge, water quality, sediment, and biology. The data are available from computer storage through the National Water Data Exchange (NAWDEX) or the published annual Water Resources Data reports for Ohio, Pennsylvania, and West Virginia. Hydrologic problems related to mining are: (1) Erosion and increased sedimentation, and (2) degradation of water quality. Erosion and sedimentation are associated chiefly with surface mining. Sediment yields increase drastically when vegetation is removed from the highly erosive soils. Degradation of water quality can be caused by acid-mine drainage from underground and surface mining. More than half the acid-mine drainage effluent in area 4 comes from underground mines. The rest seeps from abandoned surface mines. Usually in reclaimed surface mines the overburden is replaced in such a short time after the coal is taken out that oxidation of acid-forming minerals, commonly pyrite or marcasite, is not complete or is neutralized by the buffering action of calcareous minerals in the soils. (USGS)

Geology and Groundwater Resources of Western Crawford County, Pennsylvania

Schiner, G. R.; Gallaher, J. T.

Geological Survey, Harrisburg, PA. Water Resources Div.

Pennsylvania Geological Survey, Fourth Series, Water Resource Report 46, 1979. 103 p, 4 Fig, 3 Plates, 6 Tab, 31 Ref.,

Journal Announcement: SWRA1306

This report provides the necessary information on ground water (well water) to estimate with reasonable accuracy the casing requirements, potential yield, and quality of water yielded by wells drilled in western Crawford County, Pa. It should also help to understand why some wells are better than others nearby, even though they have the same depth. The report can be used as a guide by water managers, well drillers, and homeowners to help choose sites for maximum yield. The text contains a description of the aquifers (water-yielding rocks), data on depths and yields of wells, and information on the chemical quality of the ground water, and is accompanied by geologic maps and a well location map. (Woodard-USGS).

Geology and Ground-Water Resources of Northern Mercer County, Pennsylvania

Schiner, G. R.; Kimmel, G. E.

Geological Survey, Harrisburg, Pa. Water Resources Div. Resources Report 33, 1976. 136 p, 12 fig, 8 plates, 4 tab, 43 ref.,

Journal Announcement: SWRA1009

The Shenango and Stoneboro 15-minute quadrangles are about 60 miles north of Pittsburgh, Pa. These two quadrangles comprise the following 7.5 minute quadrangles; Greenville West, Greenville East, Sharpsville, Fredonia, Hadley, New Lebanon, Jackson Center, and Sandy Lake. The land surface of the area is a maturely dissected plateau covered almost entirely by glacial deposits of the Kent ice sheet (Wisconson Stage). The glacial deposits range in thickness from 0 to as much as 400 feet. The bedrock is mapped in detail and consists of rocks of Devonian, Mississippian, and Pennsylvanian age. The rocks of Devonian age are not exposed in the area but are present beneath the glacial deposits in deep bedrock valleys. The Mississippian rocks are found along valley sides and some valley bottoms, and the Pennsylvanian rocks generally underlife the uplands. Maximum yields of bedrock wells seldom exceed 100 gpm (gallons per minute), but a yield of 300 gpm is reported from one well in the lower member of the Shenango Formation. Potable water can be obtained everywhere in the area. (Woodard-USGS)

AN APPRAISAL OF THE GROUND-WATER RESOURCES OF THE UPPER SUSQUEHANNA RIVER BASIN IN PENNSYLVANIA
SEABER, PAUL R.
GEOLOGICAL SURVEY, WASHINGTON, D. C.
PREPARED IN COOPERATION WITH ATOMIC ENERGY COMM. GEOL SURV INTERIM GROUNDWATER REP, AUGUST 1968. 75 P, 6 FIG, 5 TAB, 14 REF.,
Journal Announcement: SWRA0209
THE AVAILABILITY, QUANTITY, QUALITY, VARIABILITY, AND COST OF DEVELOPMENT OF THE GROUNDWATER RESOURCES IN THE UPPER SUSQUEHANNA RIVER BASIN IN PENNSYLVANIA ARE DESCRIBED AND APPRAISED BY GEOLOGICAL FORMATIONS AND BY AREAS OF THE STATE. WATER MOVES FROM THE GROUND INTO MOST OF THE STREAMS OF THE AREA WITH A CONSEQUENTLY LARGE EFFECT ON SURFACE WATER QUANTITY AND QUALITY. IN MOST OF THE AREA, DEVELOPMENT OF GROUNDWATER SUPPLIES IS FAR BELOW THE POTENTIAL MAXIMUM DEVELOPMENT. TABLES SHOW ESTIMATED SPECIFIC CAPACITIES AND YIELDS, WELL DESIGNS, AND COSTS OF HYPOTHETICAL WELLS IN THE GEOLOGIC UNITS OF THE AREA. WATER CHEMICAL ANALYSES FROM WELLS IN ALL THE GEOLOGIC UNITS ARE ALSO TABULATED. (KNAPP-USGS)

Bituminous coal fields of Pennsylvania, Part II
Sisler, J. D., 1961
Pennsylvania Geological Survey Bulletin M6, 511 p.

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980, (duplicated see Maryland).
Staubitz, W. W.
Geological Survey, Towson, MD. Water Resources Div.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $13.75, Microfiche $3.50. Geological Survey Open-File Report 81-812, August, 1981. 103 p, 1 Fig, 6 Tab, 7 Ref.,
Journal Announcement: SWRA1510

Water Resources of Greene County, Pennsylvania-Appalachian Coal Basin

Stoner, J. D., Williams, D. R., Buckwalter, T. F., Felbinger, J. F. and Pattison, K. L.
PaDER Water resources report.

GEOHYDROLOGIC RECONNAISSANCE OF THE UPPER POTOMAC RIVER BASIN
TRAINER, F. W.; WATKINS, F. A. JR
GEOLOGICAL SURVEY, RESTON, VA.
AVAILABLE FROM SUPT OF DOCUMENTS, GPO, WASHINGTON, DC 20402, PRICE $1.95. WATER-SUPPLY PAPER 2035, 1975. 68 P, 16 FIG, 1 PLATE, 10 TAB, 53 REF.,
Journal Announcement: SWRA0823

THE UPPER POTOMAC RIVER BASIN, IN THE CENTRAL APPALACHIAN REGION IN PENNSYLVANIA, MARYLAND, VIRGINIA, AND WEST VIRGINIA, IS A HUMID TEMPERATE REGION OF DIVERSE FRACTURED ROCKS. THREE GEOHYDROLOGIC TERRANES, WHICH UNDERLIE LARGE PARTS OF THE BASIN, ARE DESCRIBED IN TERMS OF THEIR AQUIFER CHARACTERISTICS AND OF THE MAGNITUDE AND DURATION OF THEIR BASE RUNOFF: (1) FRACTURED ROCK HAVING A THIN REGOLITH, (2) FRACTURED ROCK HAVING A THICK REGOLITH, AND (3) CARBONATE ROCK. CRYSTALLINE ROCK IN THE MOUNTAINOUS PART OF THE BLUE RIDGE PROVINCE AND SHALE WITH TIGHT SANDSTONE IN THE FOLDED APPALACHIANS ARE COVERED WITH THIN REGOLITH. WATER IS STORED IN AND MOVES THROUGH FAIRLY UNMODIFIED FRACTURES. AVERAGE TRANSMISSIVITY (T) IS ESTIMATED TO BE 150 SQ FEET PER DAY, AND AVERAGE STORAGE COEFFICIENT (S), 0.005. CRYSTALLINE AND SEDIMENTARY ROCKS IN THE PIEDMONT PROVINCE AND IN THE LOWLAND PART OF THE BLUE RIDGE PROVINCE ARE COVERED WITH THICK REGOLITH. ESTIMATED AVERAGE VALUES FOR AQUIFER CHARACTERISTICS AR T, 200 SQ FEET PER DAY, AND S, 0.01 . CARBONATE ROCK, IN WHICH FRACTURES HAVE BEEN WIDENED SELECTIVELY BY SOLUTION, ESPECIALLY NEAR STREAMS, HAS ESTIMATED AVERAGE AQUIFER CHARACTERISTICS OF T, 500 SQ FEET PER DAY, AND S, 0.03-0.04. THIS ROCK IS THE MOST EFFECTIVE IN THE BASIN IN TERMS OF WATER SUPPLY AND BASE RUNOFF. ACIDIC MINE-DRAINAGE WATER, LOCAL HIGHLY MINERALIZED GROUNDWATER, AND THE HIGH NITRATE CONTENT OF GROUNDWATER IN SOME AREAS WOULD PROBABLY HAVE LITTLE ADVERSE AFFECT ON THE USE OF GROUNDWATER FOR LOW-FLOW AUGMENTATION. (WOODARD-USGS)

Preimpoundment Water Quality in the Tioga River Basin, Pennsylvania and New York
Ward, J. R.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A101909, Price codes: A07 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-1, March, 1981. 142 p, 12 Fig, 24 Tab, 17 Ref.,
Journal Announcement: SWRA1423

Acid-mine drainage entering the Tioga River above Blossburg, Pa., degrades water quality for most of its length by increasing levels of sulfate, trace elements and specific conductance, and decreasing alkalinity and pH. Mill creek near Tioga and Crooked Creek are alkaline tributaries that help to neutralize acid-mine drainage in the Tioga River. The Cowanesque River is also alkaline, but slightly affected by industrial effluents near Westfield, and has high chloride levels. Nutrient levels in the basin are generally low, but high enough to support biological activity. Diel measurements indicate that mine drainage has repressed biological activity in the Tioga River. Most of the phytoplankton samples have low diversity indices. Concentrations of many of the water-quality parameter were related to discharge using regression techniques. annual suspended-sediment yields averaged 575 tons per square mile above the downstream limit of the study. Mill Creek near Tioga and the Cowanesque River upstream from Nelson were the lowest contributors of suspended sediment. (USGS)

Preliminary Results of Preimpoundment Water-Quality Studies in the Tioga River Basin, Pennsylvania and New York

Ward, J. R.

Geological Survey, Harrisburg, Pa. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA as ADA-029 315, Price codes: A05 in paper copy, A01 in microfiche. Water-Resources Investigations 76-66, July 1976. 79 p, 23 fig, 6 tab, 13 ref.,

Journal Announcement: SWRA1006

Three impoundments have been proposed for the Tioga study area in Pennsylvania and New York. Two of the reservoirs, Tioga and Hammond Lakes, are presently under construction and will be completed in 1977. Cowanesque Lake is in the planning stages and will be started in the near future. The Tioga River and its major tributaries were sampled monthly from September 1973 to May 1975. Water quality in the Tioga River is degraded by acid-mine drainage entering the stream near Blossburg from both strip- and deep-mined areas. The stream supports few species of aquatic life from Blossburg to its confluence with Crooked Creek. Alkaline water of tributaries Mill Creek, Crooked Creek, and the Cowanesque River counteract the acidity carried downstream from Blossburg, and the water quality of the Tioga River gradually improves, supporting a more diversified population of fish and aquatic life. All of the streams in the Tioga River basin carry nutrients sufficient for algae blooms. Dissolved solids range from very high to moderately high throughout the basin. The Tioga River has high concentrations of sulfate and heavy metals, particularly iron and manganese. Dissolved oxygen was usually above 80 percent saturation and never dropped below 7.0 milligrams per liter throughout the basin. Relationships between selected water-quality parameters have been developed for the sampling stations throughout the basin. Downstream trends were also examined. (Woodard-USGS)

Sedimentation in the east branch Mahoning Creek basin, Clearfield and Jefferson Counties, Pennsylvania, June 1979 to June 1980.
Wetzel, Kim
U.S. Geological Survey Water Resources Investigation.

PREIMPOUNDMENT WATER QUALITY OF RAYSTOWN BRANCH JUNIATA RIVER AND SIX TRIBUTARY STREAMS, SOUTH-CENTRAL PENNSYLVANIA
WILLIAMS, D. R.
GEOLOGICAL SURVEY, HARRISBURG, PA.
AVAILABLE FROM THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA 22161 AS AD-A027 387, $4.00 IN PAPER COPY, $3.00 IN MICROFICHE. WATER-RESOURCES INVESTIGATIONS 76-57, JUNE 1976. 23 P, 5 FIG, 5 TAB, 5 REF. ,
Journal Announcement: SWRA0924

THE RAYSTOWN BRANCH JUNIATA RIVER WATERSHED, WHICH IS THE MAIN WATER SOURCE FOR RAYSTOWN LAKE, IS A 960-SQUARE-MILE DRAINAGE BASIN IN COLLECTED ON THE RAYSTOWN BRANCH AND SIX TRIBUTARY STREAMS IN THE BASIN. SPECIFIC CONDUCTANCE VALUES VARIED INVERSELY WITH WATER DISCHARGE. THE PH VALUES WERE EXTREMELY LOW ONLY AT THE SHOUP RUN SITE. DISSOLVED OXYGEN CONCENTRATIONS OBSERVED AT ALL SITES INDICATED A RELATIVELY HIGH OXYGEN SATURATION LEVEL THROUGHOUT THE YEAR. SEASONAL VARIATIONS IN NITRATE-N AND ORTHOPHOSPHATE-P LEVELS WERE MEASURED AT THE MAIN INFLOW STATION, SAXTON, PA. THE HIGHEST CONCENTRATIONS OF NITRATE-N AND ORTHOPHOSPHATE-P OCCURRED IN THE WINTER AND SPRING MONTHS AND THE LOWEST CONCENTRATIONS WERE MEASURED DURING THE SUMMER AND FALL. BACTERIOLOGICAL DATA INDICATED NO EXCESSIVE AMOUNTS OF FECAL MATTER PRESENT AT THE INFLOWS. SOIL SAMPLES COLLECTED AT FOUR SITES IN THE IMPOUNDMENT AREA WERE PREDOMINANTLY OF THE BARBOUR, PHILO, AND BASHER SERIES, WHICH ARE CONSIDERED TO BE HIGHLY FERTILE SOILS WITH SILT-LOAM AND SANDY-LOAM TEXTURES. MORPHOLOGICAL FEATURES OF THE LAKE BASIN AND LOW NUTRIENT LEVELS AT THE INFLOWS SHOULD PREVENT EXCESSIVE WEED GROWTH AROUND THE LAKE PERIMETER. (WOODARD-USGS)

APPRAISAL OF STREAM SEDIMENTATION IN THE SUSQUEHANNA RIVER BASIN
WILLIAMS, K. F.; REED, L. A.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
AVAILABLE FROM GPO, WASHINGTON, DC 20402-PRICE 25 CENTS (PAPER COVER) STOCK NO 2401-1228. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1532-F, 1972. 24 P, 8 FIG, 5 TAB, 30 REF.,
Journal Announcement: SWRA0512

THE SUSQUEHANNA RIVER TRANSPORTS ABOUT 3.0 MILLION TONS OF SEDIMENT ANNUALLY (110 TONS PER SQUARE MILE). ONLY ABOUT 1.8 MILLION TONS OF SEDIMENT ENTERS THE HEAD OF CHESAPEAKE BAY ANNUALLY BECAUSE SOME SEDIMENT IS TRAPPED BEHIND THE POWER DAMS ON THE LOWER SUSQUEHANNA. MEASURED ANNUAL SEDIMENT YIELDS FROM SUBBASINS IN SUSQUEHANNA RANGE FROM 40 TO 440 TONS PER SQUARE MILE. THE HIGHEST YIELDS ARE FROM PARTS OF THE GLACIATED

SECTION OF THE BASIN, IN THE ANTHRACITE COAL REGION, AND THE PIEDMONT PROVINCE. THE LOWEST YIELDS ARE FROM PARTS OF THE GLACIATED SECTION OF THE BASIN AND THE APPALACHIAN HIGH PLATEAU. THERE HAS BEEN A DOWNWARD TREND OF SEDIMENT DISCHARGE IN RECENT YEARS. IN THE FUTURE, THE HIGH SEDIMENT YIELDS ASSOCIATED WITH URBANIZATION MAY OFFSET THIS DOWNWARD TREND. (WOODARD-USGS)

Summary Groundwater Resources of Centre County, Pennsylvania

Wood, C. R.

Geological Survey, Harrisburg, PA. Water Resources Div.

Pennsylvania Department of Environmental Resources, Harrisburg. Water Resources Report 48, 1980. 60 p, 5 Fig, 1 Plate, 7 Tab, 62 Ref.,

Journal Announcement: SWRA1412

The northwest third of Centre County, Pa., lies in the Appalachian Plateaus physiographic province. The principal aquifers are the Allegheny Group, Pottsville Group, and Burgoon Sandstone. The average yield of Allegheny and Pottsville Groups is commonly high in iron. The southeast two-thirds of the county lies in the Appalachian Mountain section of the Valley and Ridge physiographic province. The average yield of nondomestic from the Old Port, Keyser, Tonoloway, Wills Creek, Nittany, and Gatesburg Formations. The water occurs in fractures, solution-enlarged in carbonate rocks. Thus, the noncarbonate rocks are susceptible to overpumping, and the carbonate-rock aquifers are easily contaminated. At least 10 springs have generally have much higher yields than those off the fracture traces. Wells in valleys generally have higher yields than those on hillsides and hilltops. (USGS)

WATER RESOURCES OF LEHIGH COUNTY, PENNSYLVANIA

WOOD, C. R.; FLIPPO, H. N. JR; LESCINSKY, J. B.; BARKER, J. L.

GEOLOGICAL SURVEY, HARRISBURG, PA.

PENNSYLVANIA GEOLOGICAL SURVEY, 4TH SERIES, WATER RESOURCE REPORT 31, 1972. 263 P, 47 FIG, 5 PLATE, 49 TAB, 83 REF.,

Journal Announcement: SWRA0715

A STUDY OF LEHIGH COUNTY, PENNSYLVANIA, WAS MADE TO DETERMINE HOW MUCH WATER IS AVAILABLE FOR MAN'S USE FROM STREAMS AND FROM THE GROUND; THE NATURAL QUALITY OF THIS WATER AND HOW MAN HAS AFFECTED ITS QUALITY; HOW THE RELATIONSHIPS BETWEEN STREAMFLOW AND GROUNDWATER INFLUENCE RECREATIONAL USE OF THE STREAMS; AND HOW FLOODING LIMITS MAN'S USE OF THE LAND. MUCH OF THE COUNTY DRAINS TO THE LEHIGH RIVER, BOTH DIRECTLY AND BY WAY OF TRIBUTARY STREAMS. ABOUT 40% OF THE 58 MILLION GALLONS OF WATER USED PER DAY IN LEHIGH COUNTY IN 1966 WAS SURFACE WATER, AND THE REMAINDER WAS GROUNDWATER. PUMPAGE OF THE FRIEDENSVILLE MINE AND OTHER ACTIVITIES OF MAN HAVE REDUCED THE FLOW OF SAUCON CREEK AT LANARK. MOST OF THE CHANGE IN FLOW TOOK PLACE FROM 1955 THROUGH 1958. AFTER 1958, THE FLOW OF LITTLE LEHIGH CREEK NEAR ALLENTOWN WAS 25% LESS THAN IN THE 1946-58

PERIOD. THE FREQUENT DRYNESS ABOVE THE CONFLUENCE WITH SWABIA CREEK REFLECTS AN INCREASE IN CHANNEL SEEPAGE THAT WAS APPARENTLY CAUSED BY A CHANGE THAT TOOK PLACE WITHIN THE AQUIFERS OF THE LITTLE LEHIGH CREEK BASIN IN 1959. THE CAUSE OF THE CHANGE IS UNKNOWN, BUT WAS PROBABLY DUE TO INCREASES IN PERMEABILITY IN THE CARBONATE ROCK AQUIFERS UNDERLYING THE BASIN RESULTING FROM THE REMOVAL OF DEBRIS FROM ONE OR MORE MAJOR FRACTURES. MOST OF THE SURFACE WATER USED BY INDUSTRY IN LEHIGH COUNTY COMES FROM THE LEHIGH RIVER, AND MOST OF THE FEW EXCEPTIONS, CONVENTIONAL TREATMENT MAKES STREAM WATERS SUITABLE FOR PUBLIC SUPPLY AND MOST INDUSTRIAL USES. MOST GROUNDWATER OCCURS ALONG JOINTS, FAULTS, AND BEDDING PLANES. MOST WELLS OBTAIN WATER FROM SEVERAL YIELDING ZONES. THE NUMBER OF YIELDING ZONES PRESENT IN ROCKS DECREASES WITH DEPTH. IN THE CARBONATE ROCKS, ABOUT 60 PERCENT OF THE WATER-BEARING ZONES IN THE UPPER 1,000 FEET OF ROCK OCCUR WITHIN 350 FEET OF THE LAND SURFACE. LARGE QUANTITIES OF GROUND WATER ARE AVAILABLE FOR INDUSTRIAL AND PUBLIC-SUPPLY USE; AT LEAST 150 MGD COULD BE PUMPED CONTINUOUSLY FROM WELLS IN LEHIGH COUNTY. (KNAPP-USGS)

GREATER PITTSBURGH REGIONAL STUDIES, REPORTS AND MAPS, APRIL 1976
GEOLOGICAL SURVEY, RESTON, VA.
GEOLOGICAL SURVEY CATALOG, 1976. 14 P.,
Journal Announcement: SWRA0920
REPORTS AND MAPS CONCERNING HYDROLOGY, GEOLOGY, AND LAND USE RELATED TO ENVIRONMENTAL EFFECTS, ARE PRODUCTS OF A COOPERATIVE PROGRAM OF GREATER PITTSBURGH REGIONAL STUDIES BY THE U.S. GEOLOGICAL SURVEY, THE PENNSYLVANIA BUREAU OF TOPOGRAPHIC & GEOLOGIC SURVEY, THE APPALACHIAN REGIONAL COMMISSION, AND THE SOUTHWESTERN PENNSYLVANIA REGIONAL PLANNING COMMISSION, THAT BEGAN IN JANUARY 1971 AND WILL CEASE OPERATIONS IN THE REGION IN JUNE, 1976. THIS CATALOG WAS PREPARED IN APRIL 1976, AT WHICH TIME A NUMBER OF REPORTS AND MAPS REMAINED TO BE COMPLETED FOR DISTRIBUTION. SOME OF THESE ARE INCLUDED, LABELLED 'IN PRESS'. OTHERS WERE NOT SUFFICIENTLY ADVANCED FOR INCLUSION. (WOODARD-USGS)

Sediment load of streams in the region, in Schneider, W. J., and others, Water resources of the Appalachian region, Pennsylvania to Alabama
Wark, J. W., 1965
U.S. Geological Survey Hydrologic Atlas, HA-198. (duplicated see Alabama and Tennessee).

Water Resources Data, Pennsylvania, published annually since 1975.

Geological Survey, Harrisburg, PA. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22151.

Water resources data for Pennsylvania consist of records of discharge and water quality of streams, contents of lakes and reservoirs, and water levels of ground-water wells. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements

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Carbonate and crystalline rock aquifers of the Valley and Ridge Provinces, eastern Tennessee
Brahana, J. V., and Macy, J. A., 1980
Nashville, Tennessee, U.S. Geological Survey Open-File Report, 23 p.

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments
Doyle, W. H. Jr
Geological Survey, NSTL Station, MS. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-542, 1981. 56 p, 4 Fig, 5 Tab, 29 Ref.,
Journal Announcement: SWRA1501

A requirement of Public Law 95-87, the Surface Mining Control and Reclamation Act of 1977, is the understanding of the hydrology in actual and proposed surface-mined areas. Surface-water data for small specific-sites and for larger areas such as adjacent and general areas are needed also to satisfy the hydrologic requirements of the Act. The Act specifies that surface-water modeling techniques may be used to generate the data and information. The purpose of this report is to describe how this can be achieved for smaller watersheds. This report also characterizes 12 'state-of-the-art' strip-mining assessment models that are to be tested with data from two data-intensive studies involving small watersheds in watersheds with specific-site data. Extending the use of modeling techniques to larger watersheds remains relatively untested, and to date the upper limits for application have not been established. The U.S. Geological Survey is currently collecting regional hydrologic data in the major coal provinces of the United States and this data will be used to help satisfy the 'general-area' data requirements of the Act. This program is reviewed and described in this report. (USGS)

Hydrology of Area 20, Eastern Coal Province, Tennessee, Georgia, and Alabama
Hollyday, E. F., and others, 1982
U.S. Geological Survey Water-Resources Investigations 82-440

Improving estimates of streamflow characteristics in the Cumberland Plateau of Tennessee by using digital land-cover data

from the Landsat satellite
Hollyday, E. F., and Hansen, C. R.
U.S. Geological Open-File Report, 62 p
The primary objective is to improve upon the regression equations used to estimate streamflow in areas affected by coal mining in the Cumberland Plateau by using land-cover information derived from digitally processed Landsat data as well as maps. The digital data will update the land-cover data base for the New River basin project "Hydrologic Effects of Coal Mining."

The usefulness of the digital land-cover data base developed from Landsat tapes and available map data will be tested by an experiment designed to compare two sets of regression equations--one containing the most up-to-date but routinely-derived basin characteristics derived from Landsat tapes.

Mapping and Measuring Land-Cover Characteristics of New River Basin, Tennessee, Using Landsat Digital Tapes
Hollyday, E. F.; Sauer, S. P.
Geological Survey, Nashville, Tenn. Water Resources Div.
Water-Resources Investigations 76-106 (open-file report), September 1976. 14 p, 13 fig, 1 tab, 3 ref.,
Journal Announcement: SWRA1006
Land-cover information is needed to select subbasins within the New River basin, Tennessee, for the study of hydrologic processes and is also needed to transfer study results to other sites affected by coal mining. This study demonstrates that digital processing of Landsat tapes can produce maps and tables of the areal extent of selected land-cover categories. The relative area of each category within the basin is agriculture, 5 percent; evergreens, 7 percent; bare earth, 6 percent; three categories of hardwoods, 81 percent; and water, rock, and uncategorized areas, each less than 1 percent. (Woodard-USGS)

Hydrology of area 16, eastern coal province, Virginia, Tennessee
Hufschmidt, P. W., and others, 1981
U.S. Geological Survey Open-File Report 81-204. (Duplicated see Virginia).

Hydrology of Area 18, Eastern Coal Province, Tennessee
May, V. J.
Geological Survey, Nashville, TN. Water Resources Div.
Geological Survey Open-File Report 81-492 (WRI), August 1981. 78 p, 30 Ref. 3 Append.,
Journal Announcement: SWRA1511

The Eastern Coal Province is divided into 24 hydrologic reporting areas. This report describes the hydrology of area 18 which is located in the Cumberland River basin in central Tennessee near the southern end of the Province. Hydrologic information and sources are presented as text, tables, maps, and other illustrations designed to be useful to mine owners, operators, and consulting engineers in implementing permit applications that comply with the environmental requirements of the 'Surface Mining Control and Reclamation Act of 1977.' Area 18 encompasses parts of three physiographic regions; from east to west the Cumberland Plateau, Highland Rim, and Central Basin. The Plateau is underlain by sandstones and shales, with thin interbedded coal beds, of Pennsylvanian age. The Highland Rim and Central Basin are underlain by limestone and dolomite of Mississippian age. Field and laboratory analyses of chemical and physical water-quality parameters of streamflow samples show no widespread water quality problems. Some streams, however, in the heavily mined areas have concentrations of sulfate, iron, manganese, and sediment above natural levels, and pH values below natural levels. Mine seepage and direct mine drainage were not sampled. Ground water occurs in and moves through fractures in the sandstones and shales and solution openings in the limestones and dolomites. Depth to water is variable, ranging from about 5 to 70 feet below land-surface in the limestones and dolomites, and 15 to 40 feet in the coal-bearing rocks. The quality of ground water is generally good. Locally, in coal-bearing rocks, acidic water and high concentrations of manganese, chloride, and iron have been detected. (USGS)

The Quality of Water Discharging from the New River and Clear Fork Basins, Tennessee

Parker, R. S.; Carey, W. P.

Geological Survey, Nashville, TN. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A103576, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-37, August, 1980. 52 p, 25 Fig, 9 Tab, 13 Ref.,

Journal Announcement: SWRA1424

Water discharging from the heavily mined New River basin is characterized by neutral pH, low dissolved solids (less than 300 milligrams per liter) and high concentrations of suspended sediment. Approximately 590,000 tons of suspended sediment were discharged from the New River basin in 1977, as compared to an estimated 20,000 tons from the relatively unmined Clear Fork basin. More than 90 percent of the suspended sediment is silt and clay. In association with these fine-grained suspended sediments are sorbed trace metals. In 1977 the New River basin discharged an estimated 17,000 tons of suspended iron while Clear Fork only discharged an estimated 600 tons.

Suspended-sediment concentration was found to be highly correlated with both suspended and total trace-metal concentrations. This correlation coupled with the nearly neutral pH of water indicates that trace metals are transported primarily in the suspended phase. The most promising indicator of the presence of coal mining was found to be dissolved sulfate. All unmined basins, sampled in this study, showed dissolved-sulfate concentrations less than 20 milligrams per liter, whereas all mined basins had dissolved-sulfate concentrations in excess of 20 milligrams per liter regardless of basin size or discharge. (USGS)

Appraisal of Hydrologic Information Needed in Anticipation of Lignite Mining in Lauderdale County, Tennessee
Parks, W. S.
Geological Survey, Memphis, TN. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-239428, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey, Water-Resources Investigations 80-54, 1981. 67 p, 16 Fig, 8 Tab, 48 Ref.,
Journal Announcement: SWRA1424

Lignite in western Tennessee occurs as lenses or beds at various stratigraphic horizons in the Coastal Plain sediments of Late Cretaceous and Tertiary age. The occurrence of this lignite has been known for many decades, but not until the energy crisis was it considered an important energy resource. In recent years, several energy companies have conducted extensive exploration programs in western Tennessee, and tremendous reserves of lignite have been found. Lauderdale County was selected as one of the counties where strip-mining of lignite will most likely occur. Lignite in this county occurs in the Jackson and Cockfield Formations, undivided, of Tertiary age. The hydrology of the county is known only from regional studies and the collection of some site-specific data. Therefore, in anticipation of the future mining of lignite, a plan is needed for obtaining hydrologic and geologic information to adequately define the hydrologic system before mining begins and to monitor the effects of strip-mining once it is begun. For this planning effort, available hydrologic, geologic, land use, and associated data were located and compiled; a summary description of the surface and shallow subsurface hydrologic system was prepared; the need for additional baseline hydrologic information was outlined; and plans to monitor the effects of strip-mining were proposed. (USGS)

Benthic populations of thirty-three stream locations draining coal reserves of Tennessee: Tennessee Technological University, Cookeville
Pennington, W., 1980

Final report to U.S. Geological Survey, Nashville
Water pollution occurs from the mining of coal when dissolved, suspended, or other solid mineral waste enters the receiving streams. This can occur from water flowing from surface or underground mines. The pollution that occurs may be physical or chemical and is usually harmful to aquatic life. Because of the increase in mining activity, the U.S. Geological Survey has initiated a monitoring program to determine the benthic macroinvertebrate populations of selected areas draining coal reserves to coincide with their current water-quality monitoring programs. This information will be used to make projections of changes that may occur and to provide baseline information for many of the areas that may be affected by future mining. This report summarizes some of that benthic macroinvertebrate information. (From author's introduction.)

Synthetic fuels development, earth science considerations
Rickert, D. A., Ulman, W. J., and Hampton, E. R., editors, 1979
U.S. Department of Interior, Geological Survey, 45 p. (Duplicated see Alabama).

Ground-water resources in the Cumberland River basin, Kentucky-Tennessee
Rima, D. R., and Mull, D. S., 1980
U.S. Geological Survey Water Resources Investigations Open-File Report 80-202, 13 p.

Hydrology of Area 4, Eastern Coal province, Pennsylvania, Ohio, and West Virginia
Roth, D. K., Engleke, M. J., Jr., and others, 1981
Columbus, Ohio, U.S. Geological Survey Open-File Report 81-343, 62 p. (Duplicated see Alabama and Ohio).

The Cumberland Plateau overthrust and geology of the Crab Orchard Mountains area, Tennessee
Stearns, R. G., 1954
Tennessee Division of Geology Bulletin 60, 47 p.

Water Resources of the Appalachian Region, Pennsylvania to Alabama
Wark, J. W., 1965, *in* Schneider, W. J., and others
U.S. Geological Survey Hydrologic Atlas HA-198, sheet no. 8 of 11. (Duplicated see Alabama and Pennsylvania).

Summary Appraisals of the Nation's Ground-Water Resources--Tennessee Region

Zurawski, A.

Geological Survey, Nashville, TN. Water Resources Div.

Available from Supt. of Documents, GPO, Washington DC, 20402; price, $1.60. Professional Paper 813-L, 1978. 35 p, 23 fig, 4 tab, 61 ref.,

Journal Announcement: SWRA1122

Ground water is an abundant but underdeveloped resource in the water-rich Tennessee Region. The estimated recharge to aquifers in the region is one-fifth to one-third of the precipitation, or about 8 trillion gallons per year. Less than one percent of this amount of ground water was used in 1970. The aquifers of the Tennessee Region are composed of carbonate rocks, unconsolidated granular material, and fractured noncarbonate rocks. Because of their great areal extent the carbonate aquifers have the greatest potential for ground-water development. Although ground water has been a little used resource in the Tennessee Region, it could play a significant role in regional water supply. However, optimum development would require a degree of knowledge of ground-water occurrence, movement and interaction with surface water that is unavailable in most of the region. Because it is an integral part of the region's water resources, ground water deserves further study and consideration in regional development planning. (Woodard-USGS)

Water Resources Data for Tennessee, Published annually since 1975

Geological Survey, Nashville, TN. Water Resources Div.

Geological Survey Water-Date Reports.

Water resources data for Tennessee consist of records of stage, discharge, and water quality of streams and springs; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Tennessee. (USGS)

### ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR CALAVERAS CREEK, SAN ANTONIO RIVER BASIN, TEXAS, 1969

ALEXANDER, J. M.

GEOLOGICAL SURVEY, AUSTIN, TEX. WATER RESOURCES DIV.

GEOLOGICAL SURVEY DATA REPORT, 1970. 56 P, 2 FIG, 3 TAB.,

Journal Announcement: SWRA0417

THIS REPORT CONTAINS THE RAINFALL, RUNOFF, AND STORAGE DATA COLLECTED DURING THE 1969 WATER YEAR FOR THE 77.2 - SQUARE - MILE AREA ABOVE THE STREAM-GAGING STATION CALAVERAS CREEK NEAR ELMENDORF, TEXAS. THERE ARE SEVEN FLOODWATER-RETARDING STRUCTURES IN THE CALAVERAS CREEK WATERSHED. THESE STRUCTURES HAVE A CAPACITY FOR TEMPORARY STORAGE OF 8,640 ACRE-FEET OF FLOOD RUNOFF FROM 26.6 OF THE 77.2 - SQUARE-MILE STUDY AREA. ALL BUT ONE OF THE STRUCTURES ARE UPSTREAM FROM CALAVERAS LAKE. THE MEAN RAINFALL FOR THE 1969 WATER YEAR WAS 30.91 INCHES, OR 112% OF THE 14 YEAR (1955-68) WEIGHTED-MEAN AVERAGE. THE AVERAGE MONTHLY-RAINFALL TOTALS RANGED FROM 0.42 INCH IN JULY TO 6.02 INCHES IN NOVEMBER. MEAN DAILY DISCHARGE AT THE STREAM-GAGING STATION, CALAVERAS CREEK NEAR ELMENDORF, WAS 1.16 CFS. THIS SHOWS THE EFFECT OF CALAVERAS DAM ON THE BASIN AS THE AVERAGE DISCHARGE FOR THE PRECEDING 14 YEARS WAS 10.7 CFS. ANNUAL RUNOFF AT THE STREAM-GAGING STATION WAS 839 ACRE-FEET, OR 0.20 INCH. THREE STORMS WERE SELECTED FOR DETAILED COMPUTATIONS INCLUDING DETAILED TIME BREAKDOWN OF RAINFALL AND DISCHARGE. HYDROGRAPHS AND MASS CURVES ARE DRAWN FOR ILLUSTRATIONS. (WOODARD-USGS)

Descriptors: *STREAMFLOW ; *RAINFALL-RUNOFF RELATIONSHIPS ; *HYDROLOGIC DATA ; *DATA COLLECTIONS ; *TEXAS; AVERAGE FLOW ; SMALL WATERSHEDS ; FLOW MEASUREMENT ; STREAM GAGES ; RUNOFF ; FLOW RATES ; FLOW CHARACTERISTICS ; STORMS ; WATERSHED MANAGEMENT ; HYDROGRAPHS ; MASS CURVES ; RESERVOIRS ; FLOOD CONTROL ; WATER STORAGE ; WATER YIELD

Section Heading Codes: 7C .(Resources Data--Evaluation, Processing and Publication); 2E .(Water Cycle--Streamflow and Runoff)

### Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas

Baker, E. T. Jr

Geological Survey, Austin, TX. Water Resources Div.

Open-file report 77-712, March 1978. 32 p, 15 fig, 1 tab, 34 ref.,

Journal Announcement: SWRA1120

The subsurface delineation of hydrogeologic units of Miocene and younger age and stratigraphic units of Paleocene to Holocene age establishes and interrelationship of these units statewide across much of the Coastal Plain of Texas. The 11 dip sections and 1 strike section, which extend from the land surface to 7,600 feet below sea level, provide continuity of correlation from the outcrop to the relatively deep subsurface. Sand containing water with less than 3,000 milligrams per liter of dissolved solids, which is shown on the sections, serves as an index of water availability of this quality. (Woodard-USGS)

Descriptors: *Groundwater availability ; *Water quality ; *Aquifer characteristics ; *Texas ; *Gulf Coastal Plain ; *Stratigraphy; Hydrogeology ; Geologic mapping ; Catahoula Sandstone ; Jasper aquifer ; Burkeville confining layer ; Evangeline aquifer ; Chicot aquifer

Section Heading Codes: 2F .(Water Cycle--Groundwater); 4B .(Water Quantity Management and Control--Groundwater Management); 2L .(Water Cycle--Estuaries)

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## SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES--TEXAS-GULF REGION

BAKER, E. T. JR; WALL, J. R.

GEOLOGICAL SURVEY, AUSTIN, TEX.

AVAILABLE FROM SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C., 20402, $2.45 IN PAPER COPY. PROFESSIONAL PAPER 813-F, 1976. 29 P, 5 FIG, 3 PLATES, 4 TAB, 100 REF.,

Journal Announcement: SWRA0915

GROUNDWATER IN THE TEXAS-GULF REGION IS A LARGE AND IMPORTANT RESOURCE THAT CAN PROVIDE A MORE SIGNIFICANT PERCENTAGE OF THE TOTAL WATER SUPPLY OF THE REGION. TOTAL WATER REQUIREMENTS WITHIN THE REGION ARE PROJECTED TO RISE SHARPLY FROM 14 MILLION ACRE-FT (17 CUBIC KILOMETRES) IN 1970 TO NEARLY 26 MILLION ACRE-FT (32 CUBIC KILOMETRES) IN 2020. ABOUT HALF OF THE WATER USED IN 1970 WAS GROUNDWATER. AN ESTIMATED TOTAL OF 1.04 BILLION ACRE-FT (1,280 CUBIC KILOMETRES) OF RECOVERABLE WATER CONTAINING LESS THAN METRES) IN THE AQUIFERS OF THE REGION. IN ADDITION, PART OF AN ESTIMATED 3.28 BILLION ACRE-FT (4,040 CUBIC KILOMETRES) OF WATER IN STORAGE BELOW 400 FT (122 METRES) IS RECOVERABLE. ALTHOUGH NOT ALL OF THE GROUNDWATER IN STORAGE IS RECOVERABLE, A SIGNIFICANT AMOUNT IS AVAILABLE FOR DEVELOPMENT; AND AN ENORMOUS QUANTITY IS ACCESSIBLE SHOULD OCCASIONS PROMPT ITS USE ON A TIME-LIMITED BASIS. (WOODARD-USGS)

Descriptors: *GROUNDWATER RESOURCES ; *AVAILABLE WATER ; *WATER QUALITY ; *REGIONAL ANALYSIS ; *HYDROLOGIC DATA; WATER SUPPLY ; WATER YIELD ; WATER STORAGE ; AQUIFER CHARACTERISTICS ; WATER UTILIZATION ; WATER DEMAND ; CONJUNCTIVE USE ; WATER RESOURCES DEVELOPMENT ; WATER RIGHTS

Section Heading Codes: 2F .(Water Cycle--Groundwater); 2K .(Water Cycle--Chemical Processes); 4B .(Water Quantity Management and Control--Groundwater Management)

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## GROUND-WATER RESOURCES OF CASS AND MARION COUNTIES, TEXAS

BROOM, M. E.

GEOLOGICAL SURVEY, AUSTIN, TEX.

TEXAS WATER DEVELOPMENT BOARD, AUSTIN, TEXAS, REPORT 135, OCTOBER 1971. 66 P, 12 FIG, 9 TAB, 29 REF.,

Journal Announcement: SWRA0508

CASS AND MARION COUNTIES, AN AREA OF 1,325 SQUARE MILES IN NORTHEAST TEXAS, ARE UNDERLAIN BY THE CYPRESS AQUIFER WHICH IS COMPOSED OF THE WILCOX GROUP, CARRIZO SAND, REKLAW FORMATION, AND QUEEN CITY SAND, ALL OF EOCENE AGE. THESE GEOLOGIC UNITS ARE HYDRAULICALLY INTERCONNECTED AND FUNCTION AS A SINGLE AQUIFER. AS A RESULT OF GROUNDWATER DEVELOPMENT, WATER LEVELS IN THE ARTESIAN SECTION OF THE AQUIFER HAVE DECLINED AS MUCH AS 109 FEET SINCE 1964. THREE AREAS IN CASS AND MARION COUNTIES HAVE BEEN AFFECTED BY PUMPING, BUT ELSEWHERE IN THE REPORT AREA, WATER LEVELS SHOW NO APPRECIABLE CHANGE. PUMPAGE OF GROUNDWATER IN 1967 WAS 3.6 MGD OR ABOUT 4,000 ACRE-FEET. ABOUT 90 MILLION ACRE-FEET OF FRESH TO SLIGHTLY SALINE WATER IS STORED IN THE CYPRESS AQUIFER. OF THAT AMOUNT, 50 MILLION ACRE-FEET IS AVAILABLE WITHIN 400 FEET OF THE LAND SURFACE. IN AREAS WHERE SATURATED (WOODARD-USGS)

GROUND-WATER RESOURCES OF WOOD COUNTY, TEXAS
BROOM, M. E.
U S GEOLOGICAL SURVEY.
TEX WATER DEVELOP BOARD REP 79, 84 P, AUG 1968. 19 FIG, 11 TAB, 35 REF.,

Journal Announcement: SWRA6804 COUNTY IN NORTHEASTERN TEXAS, ARE DESCRIBED. THE PRINCIPAL SOURCES ARE THE TERTIARY CARRIZO-WILCOX AND SPARTA-QUEEN CITY AQUIFERS. THE SAFE PERENNIAL YIELD IS ABOUT 53,000 ACRE-FT PER YR, OF WHICH ABOUT 50,000 ACRE-FT PER YR IS IN THE SPARTA-QUEEN CITY AQUIFER; THE 1965 PUMPING RATE WAS ONLY ABOUT 3,500 AC-FT PER YR. ABOUT 34 MILLION ACRE-FT OF FRESH WATER IS STORED IN THE UPPER 400 FT OF THE AQUIFER. LOW PH AND HIGH IRON CONTENT OF THE WATER MAY LIMIT LARGE-SCALE GROUNDWATER DEVELOPMENT. THE OCCURRENCE OF IRON IS PREDICTABLE, SO THAT WITH CAREFUL WELL CONSTRUCTION AND PUMPING, RELATIVELY IRON-FREE WATER CAN BE RECOVERED FROM BOTH AQUIFERS. GROUNDWATER BASIC DATA TABLES INCLUDE WELL DESCRIPTION, CHEMICAL DATA, DEPTH TO WATER, AND DRILLER'S NAMES. HYDROGRAPHS AND FLOW-DURATION CURVES OF THE STREAMS IN THE COUNTY ARE ALSO PRESENTED. A GEOLOGIC MAP AND CROSS SECTIONS, MAPS SHOWING DEPTH TO THE AQUIFERS, A MAP OF WATER LEVELS, GRAPHS SHOWING DRAWDOWN-DISTANCE-TIME, DIAGRAMS SHOWING IRON-BEARING ZONES, AND MAPS SHOWING AQUIFER THICKNESS ARE INCLUDED. (KNAPP-USGS)

GROUNDWATER RESOURCES OF GREGG AND UPSHUR COUNTIES, TEXAS
BROOM, MATTHEW E.
GEOLOGICAL SURVEY, AUSTIN, TEX.
REPORT PUBLISHED AND DISTRIBUTED BY TEXAS WATER DEVELOPMENT BOARD, PO BOX 12386, AUSTIN TEX 78711. TEXAS WATER DEVELOPMENT BOARD REPORT 101, OCT 1969. 76 P, 16 FIG, 9 TAB, 41 REF.,

Journal Announcement: SWRA0311

GREGG AND UPSHUR COUNTIES, IN NORTHEAST TEXAS, ARE UNDERLAIN BY TWO AQUIFERS THAT ARE CAPABLE OF SUSTAINING

ADDITIONAL DEVELOPMENT. THE AQUIFERS CONSIST OF THE WILCOX GROUP AND CARRIZO SAND (CARRIZO-WILCOX AQUIFER) AND THE QUEEN CITY SAND. OF THE TOTAL PUMPAGE OF 3.02 MGD IN 1966, 2.84 MGD WAS FROM THE CARRIZO-WILCOX AQUIFER. AT THE 1966 HYDRAULIC BEING TRANSMITTED THROUGH THIS AQUIFER. THE AMOUNT THAT IS PERENNIALLY AVAILABLE IS NOT KNOWN, BUT IT IS PROBABLY AT LEAST TWO TIMES THAT PUMPED IN 1966. THE WATER IN THE CARRIZO-WILCOX GENERALLY IS SOFT, BUT WITH HIGH CHLORIDE CONTENT. THE QUEEN CITY SAND, WHICH CROPS OUT OVER NEARLY 90% OF THE AREA, IS RELATIVELY UNDEVELOPED. IN 1966, ONLY 200 ACRE-FT (0.18 MGD) WAS PUMPED FROM THE AQUIFER. THE TRANSMISSIBILITY OF THE AQUIFER IS ABOUT 5,000 GPD PER FOOT AS COMPARED TO 20,000 GPD PER FOOT FOR THE CARRIZO-WILCOX. THE WATER IN THE QUEEN CITY SAND IS UNIFORMLY LOW IN MINERALIZATION EXCEPT FOR IRON. (KNAPP-USGS)

Water-Quality Records for the Hubbard Creek Watershed, Texas, October 1974 - September 1976
Davidson, H. J.
Geological Survey, Austin, TX. Water Resources Div.
Open-file report 78-98, January 1978. 46 p, 2 fig, 10 tab, 8 ref.,
Journal Announcement: SWRA1123

This report presents a compilation of water-quality data for the Hubbard Creek watershed in Texas collected during October 1974 - September 1976. The tabulated data include discharge, chemical constituents, temperature, and pH. (Woodard-USGS)

WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1967-SEPTEMBER 1969
DAVIDSON, H. J.
GEOLOGICAL SURVEY, AUSTIN, TEX.
GEOLOGICAL SURVEY OPEN-FILE REPORT (TEXAS DISTRICT), 1972. 78 P, 2 FIG, 11 TAB, 5 REF.,
Journal Announcement: SWRAU513

CHEMICAL QUALITY OF SURFACE WATERS AT 9 STREAM SITES IN THE HUBBARD CREEK WATERSHED, TEXAS ARE PRESENTED FOR THE PERIOD OCTOBER 1967 TO SEPTEMBER 1969. FOR THE SAME PERIOD, SPECIFIC CONDUCTANCE AND CHLORIDE DETERMINATIONS ARE GIVEN FOR HUBBARD CREEK RESERVOIR. THE CONDUCTIVITY CELLS WERE POSITIONED AT DIFFERENT DEPTHS IN FRONT OF THE BOTTOM-OUTLET TUBE IN THE RESERVOIR. CONTINUOUS RECORDS OF CONDUCTIVITY OF THE WATER WERE OBTAINED ABOUT 2 FEET FROM THE BOTTOM, ABOUT 30 FEET FROM THE BOTTOM, AND AT THE SURFACE. IN ADDITION, ANNUAL WATER DISCHARGE AND CHEMICAL-QUALITY DATA ARE SUMMARIZED FOR THE RESERVOIR AND STREAM SAMPLING SITES FOR THE WATER YEARS ALBANY IN 1963. (WOODARD-USGS)

GROUND-WATER RESOURCES OF BASTROP COUNTY, TEXAS
FOLLETT, C. R.

GEOLOGICAL SURVEY, AUSTIN, TEX.
TEXAS WATER DEVELOPMENT BOARD REPORT 109, MARCH 1970. 138 P, 26 FIG, 13 TAB, 32 REF.,
Journal Announcement: SWRA0318

THE PRINCIPAL FORMATIONS IN BASTROP COUNTY, TEXAS THAT YIELD OR ARE CAPABLE OF YIELDING MODERATE OR LARGE QUANTITIES OF WATER TO WELLS ARE, IN ORDER OF DECREASING YIELDS, THE WILCOX GROUP, CARRIZO SAND, QUEEN CITY SAND, AND SPARTA SAND. THE CARRIZO SAND AND THE UNDERLYING WILCOX GROUP ARE CONNECTED HYDROLOGICALLY AND FUNCTION AS A SINGLE AQUIFER. THE USE OF GROUNDWATER IS GRADUALLY INCREASING, BUT THE TOTAL OF 3.7 MGD OR 4,100 ACRE-FEET PER YEAR USED IN 1966 IS SMALL COMPARED TO THE QUANTITY AVAILABLE. ABOUT 100 MILLION ACRE-FT OF FRESH TO SLIGHTLY SALINE WATER IS IN TRANSIENT STORAGE IN THE PRINCIPAL AQUIFERS, BUT ONLY A FRACTION OF THIS WATER IS ECONOMICALLY RECOVERABLE BY KNOWN METHODS AT PRESENT COSTS. THE YIELDS OF WELLS IN BASTROP COUNTY RANGE FROM A FEW GALLONS A MINUTE TO ABOUT 1,800 GPM. YIELDS OF AT LEAST 2,000 GPM ARE POSSIBLE FROM PROPERLY CONSTRUCTED AND SCREENED WELLS IN THE CARRIZO-WILCOX AQUIFER. THE DISSOLVED-SOLIDS CONTENT OF SELECTED WATER SAMPLES RANGED FROM 67 TO 4,020 IRON IS ONE OF THE COUNTY'S CHIEF WATER-QUALITY PROBLEMS AS 74% OF THE WAS MODERATELY HARD TO VERY HARD; ABOUT 80% OF THE SAMPLES EXCEEDED 60

GROUNDWATER RESOURCES OF BRAZOS AND BURLESON COUNTIES, TEXAS
FOLLETT, C. R.
GEOLOGICAL SURVEY, AUSTIN, TEX.
TEXAS WATER DEVELOPMENT BOARD REPORT 185, JUNE 1974. 194 P, 27 FIG, 17 TAB, 34 REF.,
Journal Announcement: SWRA0722

THE GEOLOGIC FORMATIONS THAT YIELD LARGE QUANTITIES OF WATER TO WELLS IN BRAZOS AND BURLESON COUNTIES, TEXAS ARE THE WILCOX GROUP, CARRIZO SAND, QUEEN CITY SAND, SPARTA SAND, TERRACE DEPOSITS, AND FLOOD-PLAIN ALLUVIUM. THE CARRIZO SAND AND THE UNDERLYING WILCOX GROUP ARE IN HYDRAULIC CONTINUITY AND FUNCTION AS A SINGLE AQUIFER. ABOUT 34 MGD OF GROUNDWATER WAS USED FOR ALL PURPOSES IN 1969. OF THIS AMOUNT, 66% WAS USED FOR IRRIGATION, 32% FOR PUBLIC SUPPLY, AND 2% FOR INDUSTRIAL, RURAL-DOMESTIC, AND LIVESTOCK NEEDS. USE OF GROUNDWATER FOR PUBLIC SUPPLY INCREASED FROM A TOTAL OF 1.3 MGD IN 1940 TO 11 MGD IN 1969. LARGE QUANTITIES OF GROUNDWATER ARE AVAILABLE FOR DEVELOPMENT. ABOUT 290 MILLION ACRE-FEET OF FRESH TO SLIGHTLY SALINE WATER IS IN TRANSIENT STORAGE IN THE PRINCIPAL UPLAND AQUIFERS AND FLOOD-PLAIN ALLUVIUM. ABOUT 220 MILLION ACRE-FEET IS STORED IN THE CARRIZO-WILCOX AQUIFER. THE TOTAL QUANTITY OF WATER AVAILABLE FROM THE PRINCIPAL AQUIFERS WITHOUT DEPLETING THE SUPPLY IS ABOUT 64,000 ACRE-FEET PER YEAR OR 57 MGD. THE CARRIZO-WILCOX AQUIFER, QUEEN CITY SAND, AND SPARTA SAND CONTAIN WATER THAT IS GENERALLY SUITABLE FOR PUBLIC SUPPLY, MANY INDUSTRIAL USES, AND IRRIGATION.

(KNAPP-USGS)

Availability of Fresh and Slightly Saline Ground Water in the Basins of Westernmost Texas
Gates, J. S.; White, D. E.; Stanley, W. D.; Ackermann, H.
Geological Survey, Austin, TX. Water Resources Div.
Geological Survey open-file report 78-663, October 1978. 115 p, 27 Fig, 2 Tab, 49 Ref.,
Journal Announcement: SWRA1318

Significant quantities of fresh ground water occur in the basin fill of the northern Hueco bolson and lower Mesilla Valley and in the Wildhorse Flat, Michigan Flat, Lobo Flat, and Ryan Flat areas of the Salt Basin; and may occur in Red Light Draw, Presidio bolson, and Green River valley. More than 20 million acre-feet of freshwater is estimated to be in storage in the basin fill of westernmost Texas. About 12 million acre-feet, or more than half, is in El Paso County in the Hueco bolson and Mesilla Valley. In addition, the basins contain about 7 million acre-feet of slightly saline water in basin fill, in Rio Grande alluvium in the Hueco bolson and lower Mesilla Valley, and in the Capitan Limestone in the northern Salt Basin. Ground-water pumping for municipal supply and industrial use in the El Paso area caused water-level declines of as much as 74 feet during 1903-73, and pumping for irrigation in the Salt Basin caused a maximum decline of 150 feet at Lobo Flat during 1949-73. Additional development of ground water in westernmost Texas will be accompanied by further declines in water levels, and will probably induce local migration of slightly saline or poorer quality water into freshwater areas. Land-surface subsidence could occur in local areas where water-level declines are large and the basin fill contains large amounts of compressible clay. (Kosco-USGS)

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR GREEN CREEK, BRAZOS RIVER BASIN, TEXAS, 1971
HAMPTON, B. B.
GEOLOGICAL SURVEY, AUSTIN, TEX. WATER RESOURCES DIV.
OPEN-FILE REPORT (TEXAS DISTRICT), AUGUST 1973. 30 P, 2 FIG, 3 TAB.,
Journal Announcement: SWRA0705

THE U.S. SOIL CONSERVATION SERVICE IS ACTIVELY ENGAGED IN THE INSTALLATION OF FLOOD- AND SOIL-EROSION REDUCING MEASURES IN TEXAS. HYDROLOGIC INVESTIGATIONS OF SMALL WATERSHEDS WERE BEGUN BY THE U.S. GEOLOGICAL SURVEY IN 1951 AND ARE NOW BEING MADE IN 12 STUDY AREAS. THIS REPORT CONTAINS THE RAINFALL, RUNOFF, AND STORAGE DATA COLLECTED DURING THE 1971 WATER YEAR FOR THE 46.1-SQUARE-MILE AREA ABOVE THE STREAM-GAGING STATION GREEN CREEK NEAR ALEXANDER. THERE ARE EIGHT FLOODWATER-RETARDING STRUCTURES IN THE GREEN CREEK STUDY AREA WITH A TOTAL COMBINED CAPACITY OF 7,500 ACRE-FEET BELOW

THE FLOOD-SPILLWAY CRESTS, AND THEY CONTROL 22.3 SQUARE MILES, OR APPROXIMATELY 50% OF THE DRAINAGE AREA ABOVE THE STREAM-GAGING STATION. THE WEIGHTED-MEAN RAINFALL OVER THE AREA DURING THE 1971 WATER YEAR WAS 19.97 INCHES, OR 63% OF THE 1931-60 LONG-TERM MEAN ANNUAL RAINFALL OF 31.67 INCHES. THE YEARLY MEAN DISCHARGE AT THE STREAM-GAGING STATION GREEN CREEK NEAR ALEXANDER WAS 1.13 CFS, COMPARED WITH THE 13-YEAR (1959-71) AVERAGE OF 6.03 CFS. THE ANNUAL RUNOFF WAS 818 ANALYSIS AND COMPUTATION. THESE COMPUTATIONS INCLUDE A DETAILED TIME BREAKDOWN OF RAINFALL AND DISCHARGE. (WOODARD-USGS)

HYDROLOGIC STUDIES OF SMALL WATERSHEDS, GREEN CREEK, BRAZOS RIVER BASIN, TEXAS, 1955-66
HAMPTON, B. B.
GEOLOGICAL SURVEY, AUSTIN, TEX.
TEXAS WATER DEVELOPMENT BOARD, AUSTIN, REPORT 159, NOVEMBER 1972. 55 P, 23 FIG, 9 TAB, 23 REF.,
Journal Announcement: SWRA0611

HYDROLOGIC DATA WERE COLLECTED AND COMPILED FOR THE 46.1-SQUARE MILE GREEN CREEK SMALL-WATERSHED STUDY AREA, (BRAZOS RIVER BASIN, TEXAS) BETWEEN 1955 AND 1966. DURING 1954-56, EIGHT FLOOD WATER-RETARDING STRUCTURES WERE CONSTRUCTED IN THE STUDY AREA. THE RETARDING STRUCTURES PARTLY CONTROL RUNOFF FROM 22.3 SQUARE MILES AND HAVE A COMBINED CAPACITY OF 7,466 ACRE-FEET BELOW THE CRESTS OF THE EMERGENCY SPILLWAYS. OF THE 7,466 ACRE-FEET, 1,147 ACRE-FEET IS ALLOCATED TO SEDIMENTATION. IN THE 10-YEAR PERIOD OF STUDY, 37% OF ALL INFLOW (INCLUDING RAINFALL ON POOLS) TO THE EIGHT RESERVOIRS WAS CONSUMED BY EVAPORATION AND EVAPOTRANSPIRATION. MOREOVER, THIS CONSUMPTION RANGED FROM 17% OF INFLOW IN 1957 TO 94% IN 1959, AND WAS GREATER THAT 50% OF ALL INFLOW IN 5 OF THE 10 YEARS STUDIED. CHEMICAL ANALYSES OF THE WATER INDICATE THAT DISSOLVED CONSTITUENTS PROBABLY HAVE LITTLE OR NO EFFECT UPON THE FLOCCULATING CHARACTERISTICS IN RELATION TO ACCELERATED SEDIMENTATION. (WOODARD-USGS)

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA AND MUKEWATER CREEK, COLORADO RIVER BASIN, TEXAS, 1969
HEJL, H. H. JR
GEOLOGICAL SURVEY, AUSTIN, TEX. WATER RESOURCES DIV.
GEOLOGICAL SURVEY DATA REPORT, 1970. 84 P, 2 FIG, 3 TAB.,
Journal Announcement: SWRA0417

THIS REPORT CONTAINS THE RAINFALL, RUNOFF, AND STORAGE DATA COLLECTED DURING THE 1969 WATER YEAR FOR THE 70.0-SQUARE-MILE AREA ABOVE THE STREAM-GAGING STATION MUKEWATER CREEK AT TRICKHAM, TEXAS. ALL SIX OF THE FLOODWATER-RETARDING STRUCTURES IN THE MUKE WATER CREEK WATERSHED ARE UPSTREAM FROM THE STREAM-GAGING STATION. THE STRUCTURES HAVE A COMBINED CAPACITY OF 5,790 ACRE-FEET AND CONTROL AN AREA OF 27.6 SQUARE MILES, OR 39% OF THE DRAINAGE AREA. THE

WEIGHTED-MEAN RAINFALL FOR THE 1969 WATER YEAR WAS 27.76 INCHES, OR ALMOST 114% OF THE 17-YEAR (1953-1969) AVERAGE OF 24.45 INCHES. MONTHLY RAINFALL RANGED FROM 0.04 INCH IN OCTOBER TO 4.96 INCHES IN SEPTEMBER. MEAN DAILY DISCHARGE AT THE STREAM-GAGING STATION WAS 3.91 CFS, COMPARED WITH THE 18-YEAR AVERAGE OF 11.2 CFS. ANNUAL RUNOFF AT THE STREAM-GAGING STATION WAS 2,830 ACRE-FEET, OR 0.76 INCH. THREE STORMS WERE SELECTED FOR DETAILED COMPUTATION INCLUDING DETAILED TIME BREAKDOWN OF RAINFALL AND DISCHARGE. HYDROGRAPHS AND MASS CURVES ARE DRAWN FOR ILLUSTRATIONS. (WOODARD-USGS)

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR DEEP CREEK, COLORADO RIVER BASIN, TEXAS, 1970

HEJL, H. R. JR

GEOLOGICAL SURVEY, AUSTIN, TEX.

GEOLOGICAL SURVEY OPEN-FILE REPORT (TEXAS DISTRICT), APRIL 1972. 35 P, 2 FIG, 2 TAB.,

Journal Announcement: SWRA0518

THIS IS THE ELEVENTH IN A SERIES OF BASIC-DATA REPORTS PUBLISHED ANNUALLY FOR THE DEEP CREEK STUDY AREA, AND CONTAINS THE RAINFALL, RUNOFF, AND STORAGE DATA COLLECTED DURING THE 1970 WATER YEAR FOR THE 43.9-SQUARE-MILE AREA ABOVE THE STREAM-GAGING STATION DEEP CREEK NEAR MERCURY, TEXAS, AND THE 8.31-SQUARE-MILE AREA ABOVE THE STREAM-GAGING STATION DRY PRONG DEEP CREEK NEAR MERCURY, TEXAS. SIX FLOODWATER-RETARDING STRUCTURES HAVE A COMBINED TOTAL CAPACITY OF 7,030 ACRE-FEET AND REGULATE FLOODFLOW FROM 25.31 SQUARE MILES. THE WEIGHTED-MEAN RAINFALL OVER THE DEEP CREEK PORTION OF THE STUDY AREA WAS 26.91 INCHES AND OVER THE DRY PRONG DEEP CREEK PORTION 22.17 INCHES--3 AND 20 PERCENT, RESPECTIVELY, BELOW THE LONG-TERM AVERAGE RAINFALL OF 27.74 INCHES AT BROWNWOOD. THE RATIO OF RAINFALL TO RUNOFF RANGED FROM 2.8 TO 5.5 PERCENT. (WOODARD-USGS)

RECONNAISSANCE INVESTIGATION OF GROUND WATER IN THE RIO GRANDE DRAINAGE BASIN--WITH SPECIAL EMPHASIS ON SALINE GROUND-WATER RESOURCES

KELLY, T. E.

GEOLOGICAL SURVEY, RESTON, VA.

FOR SALE BY USGS, 1200 S. EADS ST., ARLINGTON, VA, 22202 PRICE $1.50 PER SET. HYDROLOGIC INVESTIGATIONS ATLAS HA-510, 1974. 4 SHEETS, 14 MAPS, 47 REF.,

Journal Announcement: SWRA0805

THE SURFACE-WATER RESOURCES OF THE RIO GRANDE DRAINAGE BASIN, COLORADO, NEW MEXICO, AND TEXAS, ARE INSUFFICIENT TO MEET PRESENT NEEDS IN MOST OF THE BASIN. GROUNDWATER SUPPLIES HAVE BEEN EXTENSIVELY DEVELOPED FOR IRRIGATION AND FOR MUNICIPALITIES. IN AREAS OF HEAVY GROUNDWATER USE, WITHDRAWALS OFTEN SUBSTANTIALLY EXCEED ANNUAL RECHARGE; THEREFORE THE GROUNDWATER IN STORAGE IS BEING DEPLETED STEADILY, WITH

ACCOMPANYING DETERIORATION IN QUALITY. GROUNDWATER IN THE RIO GRANDE BASIN CAN BE DIVIDED INTO TWO MAJOR QUALITY TYPES: FRESHWATER WHICH GENERALLY IS NEAR THE SURFACE, AND THE MORE DEEPLY BURIED SALINE WATER. FRESHWATER IS PRESENT IN SIGNIFICANT QUANTITIES IN MOST OF THE RIO GRANDE BASIN IN COLORADO AND NEW MEXICO, AND IN PARTS OF WEST TEXAS. THE GREATEST THICKNESS OF THE FRESHWATER AQUIFER IS PRESENT IN THE SAN LUIS STRUCTURAL BASIN OF COLORADO. THROUGHOUT THIS ENTIRE BASIN THE WATER TABLE GENERALLY IS LESS THAN 12 FEET BELOW THE LAND SURFACE. THE MIDDLE BASIN AREA IS CHARACTERIZED BY WELL LITHIFIED PALEOZOIC ROCKS. LIMESTONE IS THE MAJOR LITHOLOGY. THROUGHOUT MOST OF THIS AREA FRESHWATER IS PRESENT IN THE THIN ALLUVIAL DEPOSITS OF THE RIVER VALLEYS; IN OTHER AQUIFERS THE WATER RANGES IN QUALITY FROM SLIGHTLY SALINE TO BRINE. THE LOWER BASIN REGION IS SIMILAR TO THE MIDDLE BASINS, BUT THE ROCKS GENERALLY ARE MESOZOIC IN AGE AND THE GROUNDWATER IS LESS HIGHLY MINERALIZED. THE MAJOR AQUIFERS IN THE REGION ARE LIMESTONE AND MARL OF CRETACEOUS AGE WHICH GENERALLY YIELD FRESHWATER TO WELLS AT SHALLOW (KNAPP-USGS)

Hydrologic Data for North Creek Trinity River Basin, Texas, 1979
Kidwell, C. C.
Geological Survey, Austin, TX. Water Resources Div.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $4.75, Microfiche $3.50. Geological Survey Open-File Report 81-823, August, 1981. 38 p, 2 Fig, 3 Tab.,
Journal Announcement: SWRA1509

This report contains rainfall and runoff data collected during the 1979 water year for the 21.6-square mile area above the stream-gaging station North Creek near Jacksboro, Texas. A continuous water-stage recording gage was installed at one representative floodwater-retarding structure (site 28-A) on Oct. 5, 1972. The data are collected to compute the contents, surface area, inflow, and outflow at this site. The stream-gaging station on North Creek near Jacksboro continuously records the water level which, with measurements of streamflow, is used to compute the runoff from the study area. Streamflow records at this gage began on Aug. 8, 1956. Detailed rainfall-runoff computations are included for one storm during the 1979 water year at the stream-gaging station. (USGS)

Hydrologic Data for North Creek Trinity River Basin, Texas, 1975
Kidwell, C. C.
Geological Survey, Austin, Tex. Water Resources Div.
Open-file report 76-724, April 1977. 50 p, 2 fig, 3 tab.,
Journal Announcement: SWRA1023

This report contains the rainfall, runoff, and storage data collected during the 1975 water year for the

21.6-square-mile area above the stream-gaging station North Creek near Jacksboro, Texas. The weighted-mean rainfall in the study area during the water year was 39.01 inches, which is greater than the 18-year average of 30.21 inches for the period 1958-75. Monthly rainfall totals ranged from 1.04 inches in November to 7.94 inches in May. The mean discharge for 1975 at the stream-gaging station was 5.98 cfs, compared with the 14-year (1957-70) average of 5.75 cfs. The annual runoff from the basin above the stream-gaging station was 4,330 acre-feet or 3.76 inches. Three storms were selected for detailed computations for the 1975 water year. The storms occurred on Oct. 30-31, 1974, May 2, 1975, and Aug. 26, 1975. Rainfall and discharge were computed on the basis of a refined time breakdown. Patterns of the storms are illustrated by hydrographs and mass curves. A summary of rainfall-runoff data is tabulated. There are five floodwater-retarding structures in the study area. These structures have a total capacity of 4,425 acre-feet below flood-spillway crests and regulate streamflow from 16.3 square miles, or 75 percent of the study area. A summary of the physical data at each of the floodwater-retarding structures is included. (Woodard-USGS)

HYDROLOGIC DATA FOR NORTH CREEK TRINITY RIVER BASIN, TEXAS, 1974
KIDWELL, C. C.
GEOLOGICAL SURVEY, AUSTIN, TEX.
OPEN-FILE REPORT, MAY 1976. 40 P, 2 FIG, 3 TAB.,
Journal Announcement: SWRA0919

THIS REPORT CONTAINS THE RAINFALL, RUNOFF, AND STORAGE DATA COLLECTED DURING THE 1974 WATER YEAR FOR THE 21.6 SQ MI AREA ABOVE THE STREAM-GAGING STATION NORTH CREEK NEAR JACKSBORO, TEXAS. THE LOCATIONS OF FLOODWATER-RETARDING STRUCTURES AND HYDROLOGIC INSTRUMENT INSTALLATIONS IN THE AREA ARE SHOWN. FIVE FLOODWATER-RETARDING STRUCTURES HAVE A COMBINED CAPACITY OF 4,425 ACRE-FT BELOW FLOOD-SPILLWAY CRESTS AND REGULATE STREAMFLOW FROM 16.3 SQ MI, OR 75 PERCENT OF THE STUDY AREA. THE SLIGHTLY LESS THAN THE 17-YEAR AVERAGE OF 29.69 IN. FOR THE PERIOD 1958-74. MONTHLY RAINFALL TOTALS RANGED FROM 0.00 IN. IN DECEMBER TO 7.07 IN. IN AUGUST. THE YEARLY MEAN DISCHARGE AT THE STREAM-GAGING STATION WAS 1.13 CFS, COMPARED WITH THE 14-YEAR (1957-70) AVERAGE OF 5.75 CFS, PRIOR TO THE NOTABLE EFFECT CAUSED BY THE FLOODWATER-RETARDING STRUCTURES. THE ANNUAL RUNOFF FROM THE BASIN ABOVE THE STREAM-GAGING STATION WAS 821 ACRE-FT. TWO STORMS WERE SELECTED FOR DETAILED COMPUTATIONS FOR THE 1974 WATER YEAR. THE STORMS SELECTED OCCURRED ON OCT. 12, 1973 AND AUG. 29, 1974. RAINFALL AND DISCHARGE WERE COMPUTED ON THE BASIS OF A REFINED TIME BREAKDOWN. PATTERNS OF THE STORMS ARE ILLUSTRATED BY HYDROGRAPHS AND MASS CURVES. (WOODARD-USGS)

Hydrologic Data for North Creek, Trinity River Basin, Texas, 1978

Kidwell, C. C.

Geological Survey, Austin, TX. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $5.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-573, August, 1980. 44 p, 2 Fig, 3 Tab.,

Journal Announcement: SWRA1415

This report contains rainfall and runoff data collected during the 1978 water year for the 21.6-square mile area above the stream-gaging station North Creek near Jacksboro, Texas. A continuous water-stage recording gage was installed at one representative floodwater-retarding structure (site 28-A) on Oct. 5, 1972. The data are collected to compute the contents, surface area, inflow, and outflow at this site. The stream-gaging station on North Creek near Jacksboro continuously records the water level which, with measurements of streamflow, is used to compute the runoff from the study area. Streamflow records at this gage began on Aug. 8, 1956. Detailed rainfall-runoff computations are included for two storm periods during the 1978 water year at the stream-gaging station. (USGS)

Hydrologic Data for North Creek, Trinity River Basin, Texas, 1976

Kidwell, C. C.

Geological Survey, Austin, TX. Water Resources Div.

Geological Survey open-file report 77-732, July 1978. 42 p, 2 fig, 3 tab. ,

Journal Announcement: SWRA1216

This report contains rainfall and runoff data collected during the 1976 water year for a 21.6-square mile area above the stream-gaging station on North Creek near Jacksboro, Texas. A continuous water-stage recording gage was installed at one representative floodwater-retarding structure (site 28-A) on Oct. 5, 1972. The data are used to compute the contents, surface area, inflow, and outflow at this site. The stream-gaging station on North Creek near Jacksboro continuously records the water level which, with measurements of streamflow, is used to compute the runoff from the study area. Streamflow records at this gage began on Aug. 8, 1956. Detailed rainfall-runoff computations, including hydrographs and mass curves, are included for two storm periods during the 1976 water year at the stream-gaging station. (Woodard-USGS)

RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE NUECES RIVER BASIN, TEXAS

KUNZE, H. L.

GEOLOGICAL SURVEY, AUSTIN, TEX.

TEXAS WATER DEVELOPMENT BOARD REPORT 134, SEPTEMBER 1971. 34 P, 8 FIG, 5 TAB, 34 REF.,

Journal Announcement: SWRA0508

THE KINDS AND QUANTITIES OF MINERALS DISSOLVED IN SU.FACE WATERS OF THE NUECES RIVER BASIN IN TEXAS ARE RELATED PRINCIPALLY TO THE GEOLOGY OF THE AREA AND TO RAINFALL AND STREAMFLOW CHARACTERISTICS; BUT INDUSTRIAL INFLUENCES, PARTICULARLY THE DISPOSAL OF OIL-FIELD BRINE, HAVE AFFECTED THE QUALITY IN SOME AREAS. THE BASIN LIES IN TWO PHYSIOGRAPHIC SECTIONS--THE EDWARDS PLATEAU OF THE GREAT PLAINS PROVINCE AND THE WEST GULF COASTAL PLAIN OF THE COASTAL PLAIN PROVINCE. THE EDWARDS AND ASSOCIATED LIMESTONES AND THE GLEN ROSE LIMESTONE OF CRETACEOUS AGE ARE EXPOSED ON THE EDWARDS PLATEAU. ROCKS EXPOSED IN THE WEST GULF COASTAL PLAIN RANGE IN AGE FROM THE PRINCIPAL CONSTITUENTS ARE CALCIUM AND BICARBONATE. DURING LOW FLOW THE DISSOLVED-SOLIDS CONCENTRATIONS, IN WHICH SODIUM AND CHLORIDE PREDOMINATE. DURING THE SHORT PERIODS OF HIGH FLOW, DISSOLVED-SOLIDS CONCENTRATIONS ARE LOW AND CALCIUM AND BICARBONATE ARE THE PRINCIPAL CONSTITUENTS. LAKE CORPUS CHRISTI PROVIDES WATER OF GOOD QUALITY FOR MUNICIPAL SUPPLY, IRRIGATION, AND INDUSTRIAL USE. (WOODARD-USGS)

RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE SULFUL RIVER AND CYPRESS CREEK BASINS, TEXAS

LEIFESTE, DONALD K.

GEOLOGICAL SURVEY, AUSTIN, TEX.

TEX WATER DEVELOP BOARD REP NO 87, DEC 1968. 32 P, 13 FIG, 6 TAB, 29 REF. ,

Journal Announcement: SWRA0211

THE SULPHUR RIVER AND CYPRESS CREEK BASINS ARE FREE OF SERIOUS WATER-QUALITY PROBLEMS. CONTINUED MUNICIPAL AND INDUSTRIAL GROWTH WILL INCREASE THE WASTE-DISPOSAL BURDENS OF THE STREAMS, AND PLANNED IMPOUNDMENTS WILL CAUSE A REDUCTION IN THE STREAMFLOW WHICH NOW AIDS IN WASTE ASSIMILATION. AS THE WATER RESOURCES OF THE BASINS ARE DEVELOPED, THE MAGNITUDE AND SIGNIFICANCE OF THE PROBABLE CHANGES IN WATER QUALITY WILL NECESSITATE STUDIES OF THE RESULTING PROBLEMS. THE SULPHUR RIVER AND CYPRESS CREEK BASINS ARE ADJACENT BASINS IN THE NORTHEAST CORNER OF TEXAS. THEIR COMBINED DRAINAGE AREA IN TEXAS IS 6.370 SQ MI. BOTH BASINS ARE COMPLETELY WITHIN THE WEST GULF COASTAL PLAIN SECTION OF THE COASTAL PLAIN PHYSIOGRAPHIC PROVINCE. THE CLIMATE OF THE STUDY BASINS RANGES FROM MOIST SUBHUMID TO HUMID. THE AVERAGE ANNUAL PRECIPITATION RANGES FROM 42 IN. IN THE WEST TO 48 IN. IN THE EAST AND AVERAGES ABOUT 45 IN. ABOUT ONE-FOURTH OF THE PRECIPITATION APPEARS IN THE STREAMS AS RUNOFF. SURFACE WATER IN THE SULPHUR RIVER AND CYPRESS CREEK BASINS IS GENERALLY OF GOOD CHEMICAL QUALITY AND IS SUITABLE FOR MOST MUNICIPAL, INDUSTRIAL AND AGRICULTURAL PURPOSES. THE KINDS AND QUANTITIES OF MINERALS DISSOLVED IN SURFACE WATERS OF THE BASINS ARE RELATED PRINCIPALLY TO THE GEOLOGY OF THE RUNOFF AREA AND TO RAINFALL AND STREAMFLOW CHARACTERISTICS, BUT ARE ALSO AFFECTED BY INDUSTRIAL ACTIVITIES. THE WATER IN STREAMS IS USUALLY LOW IN CONCENTRATION OF DISSOLVED MATERIALS. WATER FROM THE CRETACEOUS AND TERTIARY

ROCKS IN THE SULPHUR RIVER BASIN IS GENERALLY OF A MIXED TYPE CONTAINING LESS THAN 250 PPM DISSOLVED SOLIDS, EXCEPT IN THE WHITE OAK CREEK SUBBASIN WHERE OIL-FIELD DRAINAGE INTERMITTENTLY DEGRADES THE QUALITY OF THE WATER. IN THE CYPRESS CREEK BASIN, THE CRETACEOUS ROCKS CONTRIBUTE A SODIUM CHLORIDE TYPE WATER THAT GENERALLY CONTAINS LESS THAN 250 PPM DISSOLVED SOLIDS. THE CHLORIDE CONTENT OF THE SURFACE WATERS IS GENERALLY LESS THAN 25 PPM, LXCEPT WHERE OIL-FIELD DRAINAGE IS AFFECTING THE QUALITY OF THE WATER. ALL THE RESERVOIRS IN THE BASINS CONTAIN WATER OF VERY GOOD QUALITY. THE DISSOLVED-SOLIDS CONCENTRATION IS USUALLY LESSTHAN 150 PPM. WATER AVAILABLE FOR STORAGE AT POTENTIAL RESERVOIRS IS ALSO OF VERY GOOD QUALITY. (KNAPP-USGS)

RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE COLORADO RIVER BASIN, TEXAS
LEIFESTE, DONALD K.; LANSFORD, MYRA W.
US GEOLOGICAL SURVEY
TEX WATER DEVELOP BOARD REP 71, 78 P, MAR 1968. 13 FIG, 6 TAB, 26 REF.,
Journal Announcement: SWRA6801

THE NATURAL RUNOFF FROM MOST OF THE 40,000 SQ MI COLORADO RIVER BASIN IS OF GOOD CHEMICAL QUALITY AND SUITABLE FOR MOST USES. MINERAL QUALITY OF THE WATER IS RELATED TO GEOLOGY, RAINFALL, AND STREAMFLOW EXCEPT BELOW LAKE J. B. THOMAS WHERE INFLOW FROM OIL-FIELD BRINES IMPAIR THE QUALITY. MOST OF THE TRIBUTARY INFLOWS HAVE LESS THAN 250 PPM DISSOLVED SOLIDS, BUT WATER IN THE MAIN STEM DOWNSTREAM FROM THE AREA OF SALINE INFLOW IS GENERALLY ABOVE 250 PPM. THE WATER RANGES FROM MODERATELY HARD TO VERY HARD, AND CHLORIDE CONCENTRATIONS RANGE FROM LESS THAN 50 PPM TO SEVERAL THOUSAND PPM. CHLORIDE IS HIGHEST IN THE UPPER REACHES WHERE BRINES REACH THE STREAMS. MAJOR WATER-SUPPLY RESERVOIRS ALL HAVE WATER OF ACCEPTABLE QUALITY FOR MOST USES. THE QUALITY OF WATER THAT WILL BE STORED IN ROBERT LEE RESERVOIR, NOW SALINE WATER. SMALL-SCALE MAPS SHOW THE RANGE IN PRECIPITATION AND RUNOFF; LOCATIONS OF RESERVOIRS, OIL FIELDS, GAGING STATIONS, AND CHEMICAL-QUALITY SAMPLING SITES; AND GEOLOGY. IMPORTANT TABLES GIVE THE SOURCE, SIGNIFICANCE, AND INDUSTRIAL TOLERANCES FOR VARIOUS MINERAL CONSTITUENTS; AN INDEX TO SURFACE-WATER RECORDS; SUMMARY OF CHEMICAL QUALITY ANALYSES AT DAILY STATIONS; AND CHEMICAL ANALYSES OF WATER FROM OTHER STATIONS.

Progress Report on Geology of the Edwards Aquifer, San Antonio Area, Texas, and Preliminary Interpretation of Borehole Geophysical and Laboratory Data on Carbonate Rocks
Maclay, R. W.; Small, T. A.
Geological Survey, San Antonio, Tex. Water Resources Div.
Open-file report 76-627, November 1976. 65 p, 20 fig, 3 tab, 33 ref.,
Journal Announcement: SWRA1011

The Edwards aquifer, which is one of the most productive aquifers in the southwestern military installations, and 17 communities in South Texas. San Antonio, which has a population of about 750,000, obtains its entire water supply from the Edwards. The primary purpose of this progress report is to describe the geology and porosity of the rocks of the Edwards aquifer in the San Antonio and to present preliminary interpretations of borehole geophysical and laboratory data. The data were obtained from geophysical and geologic studies of nine cored test holes, from laboratory analyses of samples of aquifer materials, and from recent stratigraphic studies by Rose (1972). The aquifer is areally divided into a fresh-water zone and a saline zone at the 'bad-water' line. The bad-water line forms the southern boundary of the fresh-water zone and its position is determined by the Rock characteristics and water chemistry in the fresh-water one differ markedly from those of the saline zone. The high permeability of the aquifer within the fresh-water zone results from open fractures and selectively dissolved facies. (Woodard-USGS)

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR GREEN CREEK, BRAZOS RIVER BASIN, TEXAS--1969
MASSEY, B. C.
GEOLOGICAL SURVEY, AUSTIN, TEX.
GEOLOGICAL SURVEY DATA REPORT, 1970. 44 P, 2 FIG, 3 TAB.,
Journal Announcement: SWRA0416

THIS REPORT WHICH IS THE TENTH IN A SERIES OF BASIC-DATA REPORTS PUBLISHED ANNUALLY FOR THE GREEN CREEK STUDY AREA, CONTAINS THE RAINFALL, RUNOFF, AND STORAGE DATA COLLECTED DURING THE 1969 WATER YEAR (OCT. 1968 - SEPT. 1969) FOR THE 46.1-SQUARE-MILE AREA ABOVE THE STREAM-GAGING STATION GREEN CREEK NEAR ALEXANDER, TEXAS. THE LOCATIONS OF THE FLOODWATER-RETARDING STRUCTURES AND HYDROLOGIC INSTRUMENTS IN THE AREA ARE SHOWN. THE WEIGHTED-MEAN RAINFALL WAS 31.01 INCHES, OR 98 PERCENT OF THE 1931-60 LONG-TERM MEAN ANNUAL RAINFALL OF 31.67 INCHES IN DUBLIN, TEXAS. THE MEAN DAILY DISCHARGE AT THE STREAM-GAGING STATION GREEN CREEK NEAR ALEXANDER WAS 12.7 CFS COMPARED WITH THE 11-YEAR (1958-69) AVERAGE OF 6.14 CFS. THREE STORM PERIODS WERE SELECTED FOR DETAILED ANALYSIS AND COMPUTATION. THESE COMPUTATIONS INCLUDE DETAILED TIME BREAKDOWN OF RAINFALL AND DISCHARGE, HYDROGRAPHS, AND MASS CURVES. THE STORMS SELECTED OCCURRED ON APRIL 12, 1969, MAY 6-7, 1969, AND JULY 27, 1969. A SUMMARY OF RAINFALL-RUNOFF DATA FOR THESE STORMS IS TABULATED. COMPUTATIONS ALONG THE HYDROGRAPHS AND MASS CURVES FOR THE STORMS ARE SHOWN IN THE COMPILATION AND ANALYSIS OF DATA. (WOODARD-USGS)

Application of a Rainfall-Runoff Model in Estimating Flood Peaks for Selected Small Natural Drainage Basins in Texas
Massey, B. C.; Schroeder, E. E.
Geological Survey, Austin, TX. Water Resources Div.
Open-file report 77-792, December 1977. 23 p, 2 fig, 4 tab, 13 ref.,
Journal Announcement: SWRA1114

A parametric rainfall-runoff simulation model was used to synthesize long-term records of annual peak discharges for small natural drainage basins in Texas. Optimum model-parameter values were determined for each of the 40 basins studied by using short-term rainfall, evaporation, and discharge data. The calibrated model was used in conjunction with long-term records of rainfall and evaporation to synthesize a record of annual peaks for each site. Because the frequency curves of the simulated peaks had flatter slopes than those of the observed peaks, the synthetic frequency curves were adjusted for the loss of variance inherent in the modeling process. (Woodard-USGS)

RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE RIO GRANDE BASIN, TEXAS

MENDIETA, H. B.

GEOLOGICAL SURVEY, AUSTIN, TEX.

TEXAS WATER DEVELOPMENT BOARD REPORT 180, MARCH 1974. 109 P, 10 FIG, 11 TAB, 48 REF.,

Journal Announcement: SWRA0716

THE KINDS AND QUANTITIES OF MINERALS DISSOLVED IN SURFACE WATERS OF THE RIO GRANDE BASIN ARE RELATED PRINCIPALLY TO THE GEOLOGY OF THE AREA AND RETURN FLOW FROM IRRIGATION. DURING PERIODS WHEN THE FLOW CONSISTS PRINCIPALLY OF SEEPAGE FROM THE QUATERNARY DEPOSITS AND RETURN FLOW FROM IRRIGATION, WATER IN THE UPPER REACH OF THE RIO GRANDE USUALLY IS SLIGHTLY SALINE AND VERY HARD. WATER IN THE UPPER REACH OF THE PECOS RIVER AND MOST OF ITS TRIBUTARIES THAT TRAVERSE THE QUATERNARY DEPOSITS IS SLIGHTLY TO TRIBUTARY THAT TRAVERSES THE TERTIARY DEPOSITS IN THE MEXICAN SIDE OF THE BASIN, IS FRESH AND VERY HARD. MUCH OF THE MIDDLE REACH OF THE RIO GRANDE BASIN IS UNDERLAIN BY ROCKS OF CRETACEOUS AGE. WATER IN STREAMS THAT TRAVERSE THESE DEPOSITS USUALLY IS FRESH AND HARD. INFLOW FROM THE RIO CONCHOS AND OTHER TRIBUTARIES AND FROM SPRINGS MORE THAN COMPENSATES FOR THE SALINE INFLOW FROM THE PECOS RIVER, AND RESULTS IN A DECREASE IN DISSOLVED CONSTITUENTS IN THE MIDDLE REACH OF THE RIO GRANDE. WATER IN THE INTERNATIONAL FALCON RESERVOIR ON THE LOWER RIO GRANDE IS USED FOR MUNICIPAL SUPPLY, INDUSTRY, AND IRRIGATION. RETURN FLOW FROM IRRIGATION CAUSES AN INCREASE IN DISSOLVED CONSTITUENTS DOWNSTREAM FROM THE RESERVOIR. THE CONCENTRATIONS OF DISSOLVED SOLIDS AND SULFATE IN THE RIO GRANDE UPSTREAM FROM THE RIO CONCHOS USUALLY EXCEED THE LIMITS RECOMMENDED BY THE U.S. PUBLIC HEALTH SERVICE FOR DRINKING WATER. WATER IN THE PECOS RIVER AND SOME OF ITS TRIBUTARIES IS UNDESIRABLE FOR DOMESTIC OR INDUSTRIAL USE BECAUSE THE WATER USUALLY CONTAINS EXCESSIVE CONCENTRATIONS OF DISSOLVED SOLIDS, SULFATE, AND CHLORIDE. WATER IN MOST OF THE OTHER STREAMS USUALLY IS SUITABLE FOR DOMESTIC SUPPLY AND MANY INDUSTRIAL USES. THE SODIUM HAZARD OF WATER IN THE RIO GRANDE USUALLY RANGES FROM LOW TO MEDIUM; THAT OF THE PECOS RIVER USUALLY IS VERY HIGH. THE SALINITY HAZARD OF WATER IN THE RIO GRANDE AND PECOS RIVER USUALLY IS HIGH OR VERY HIGH. (KNAPP-USGS)

TRAVEL TIME FOR SOLUTES, UPPER SABINE RIVER BASIN, TEXAS, APRIL 16-30, 1972

MILLS, W. B.

GEOLOGICAL SURVEY, WASHINGTON, D.C.

GEOLOGICAL SURVEY OPEN-FILE REPORT 1972. 2 SHEETS, 2 FIG, 2 TAB, 2 REF.,

Journal Announcement: SWRA0610

THE U.S. GEOLOGICAL SURVEY, IN COOPERATION WITH THE SABINE

RIVER COMPACT ADMINISTRATION, CONDUCTED TIME-OF-TRAVEL STUDIES USING RHODAMINE WT DYE IN THE SABINE RIVER BASIN, TEXAS, ON APRIL 16-30, 1972. ONE STUDY WAS MADE ON THE MAIN STEM OF THE SABINE RIVER IN FOUR REACHES FROM LAKE TAWAKONI TO TOLEDO BEND RESERVOIR, A DISTANCE OF 219 MILES. TWO OTHER STUDIES WERE MADE ON REACHES OF LAKE FORK CREEK AND BIG SANDY CREEK. THE PURPOSE WAS TO PROVIDE TRAVEL-RATE DATA TO BE USED BY THE SABINE RIVER AUTHORITY OF TEXAS IN CONSTRUCTING A HYDROLOGIC MODEL OF THE BASIN. THE AVERAGE VELOCITY IN THE SABINE RIVER SHOWED AN OVERALL INCREASE FROM 0.33 FPS IN THE UPSTREAM REACH TO 0.81 FPS AT THE DOWNSTREAM END, EVEN THOUGH THE VELOCITY FLUCTUATED BETWEEN ADJOINING REACHES. AVERAGE VELOCITIES IN THE TRIBUTARY STREAMS RANGED FROM 0.08 FPS TO 0.30 FPS. THE HIGHER VELOCITIES OCCURRED AFTER RUNOFF FROM THE STORM ON APRIL 27 ENTERED THE STREAMS. MAPS, TABLES, AND HYDROGRAPHS SUMMARIZE THE DATA ON TWO SHEETS (APPROXIMATELY 17 X 21 IN). THE DATA INCLUDE LOCATIONS OF SAMPLING SITES, WATER QUALITY, PROFILES AND AVERAGE VELOCITY OF DYE PEAKS, AND SHAPE OF THE DYE CLOUD AT EACH MEASURING POINT. (WOODARD-USGS)

WATER BUDGET AND QUALITY OF WATER STUDIES OF HUBBARD CREEK RESERVOIR, TEXAS, 1963-67 WATER YEARS

MYERS, B. N.

GEOLOGICAL SURVEY, AUSTIN, TEX.

TEXAS WATER DEVELOPMENT BOARD REPORT 151, JUNE 1972. 9 P, 1 FIG, 2 TAB, 15 REF.,

Journal Announcement: SWRA0520

THE RESULTS OF A WATER BUDGET AND CHEMICAL QUALITY OF WATER STUDY OF HUBBARD CREEK RESERVOIR (TEXAS) ARE PRESENTED. DATA COLLECTED PERMITTED COMPUTATION OF WATERSHED PRECIPITATION, INFLOW AND OUTFLOW OF THE RESERVOIR, EVAPORATION, AND CHEMICAL ANALYSIS OF WATER. SMALL WATER LOSSES WERE ATTRIBUTED TO SATURATION OF ALLUVIUM IN THE RESERVOIR BASIN DURING THE INITIAL FILLING OF THE RESERVOIR. BECAUSE THERE ARE NO GROUNDWATER AQUIFERS OF IMPORTANCE IN THE WATERSHED, AND BECAUSE THE SEDIMENTS WITHIN THE DRAINAGE BASIN ARE RELATIVELY IMPERMEABLE, NO LARGE AMOUNTS OF WATER ARE LOST BY INFILTRATION. DURING THE PERIOD 1963-67, ABOUT 110,000 ACRE-FEET OF WATER WAS LOST BY EVAPORATION. THIS AMOUNT REPRESENTS ABOUT 30% OF THE CAPACITY OF THE RESERVOIR AT NORMAL OPERATING LEVEL. WATER-SAMPLE ANALYSES FROM TRIBUTARIES PASSING THROUGH OIL FIELDS INDICATE THAT INDUSTRIAL WASTE CONTRIBUTES TO MINERALIZATION OF THE RESERVOIR WATER. (WOODARD-USGS)

TIME-OF-TRAVEL OF SOLUTES IN THE TRINITY RIVER BASIN, TEXAS, SEPTEMBER 1973 AND JULY-AUGUST 1974

OLLMAN, R. H.

GEOLOGICAL SURVEY, FORT WORTH, TEX.

OPEN-FILE REPORT 75-558, NOVEMBER 1975. 3 SHEETS, 2 FIG, 2 TAB.,

Journal Announcement: SWRA0911

THE U. S. GEOLOGICAL SURVEY, IN COOPERATION WITH THE U. S. ARMY CORPS OF ENGINEERS AND THE TRINITY RIVER AUTHORITY OF TEXAS, CONDUCTED TIME-OF-TRAVEL STUDIES IN THE TRINITY RIVER BASIN DURING A PERIOD OF LOW FLOW SEPTEMBER 19-23, 1973, AND DURING A PERIOD OF MODERATE FLOW JULY 23-AUGUST 1, 1974. THE PURPOSE OF THESE STUDIES WAS TO PROVIDE DATA THAT COULD BE USED BY THE TRINITY RIVER AUTHORITY AS PART OF THE BASIC INPUT TO A MATHEMATICAL WATER-QUALITY MODEL OF THE RIVER. THE MODEL IS BEING DEVELOPED AS PART OF A COMPREHENSIVE WATER-QUALITY MANAGEMENT PLAN FOR THE BASIN. THE TIME-OF-TRAVEL OF SOLUTES IN THE TRINITY RIVER AND WEST FORK TRINITY RIVER WAS DETERMINED BY INJECTING A FLUORESCENT DYE (RHODAMINE WT, 20-PERCENT SOLUTION) THAT COULD BE DETECTED BY FLUOROMETRIC ANALYSIS OF WATER SAMPLES COLLECTED AT SELECTED DOWNSTREAM SITES. PLOTS OF OBSERVED DYE CONCENTRATION VERSUS TIME WERE MADE FOR EACH INJECTION AND SAMPLING SITE, AND A SMOOTH CURVE WAS DRAWN. THE RESULTING CURVES WERE THEN USED TO DETERMINE ARRIVAL TIMES OF THE LEADING EDGE, THE PEAK, AND THE TRAILING EDGE OF THE DYE CLOUD. THE TRAILING EDGE WAS DEFINED AS THE CONCENTRATION VALUE EQUAL TO 10 PERCENT OF THE PEAK CONCENTRATION. MEASUREMENTS OF THE CONCENTRATION AND DISPERSION OF THE DYE PROVIDE INFORMATION ON THE PROBABLE BEHAVIOR OF SOLUBLE CONTAMINANTS THAT MIGHT BE INTRODUCED IN THE REACHES STUDIED. (WOODARD-USGS)

GEOHYDROLOGIC SIGNIFICANCE OF LITHOFACIES OF THE COCKFIELD FORMATION OF LOUISIANA AND MISSISSIPPI AND OF THE YEGUA FORMATION OF TEXAS
PAYNE, J. N.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
AVAILABLE FROM SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D.C. 20402 - $6.25 (INCLUDING PLATES IN SEPARATE CASE). GEOLOGICAL SURVEY PROFESSIONAL PAPER 569-B, 1970. 14 P, 2 FIG, 8 PLATE, 1 TAB, 63 REF. (PLATES UNDER SEPARATE COVER).,
Journal Announcement: SWRA0413

SAND-PERCENTAGE AND MAXIMUM SAND-UNIT THICKNESS MAPS SHOW THAT THE COCKFIELD AND YEGUA FORMATIONS IN LOUISIANA, MISSISSIPPI, AND EASTERN TEXAS CONSISTS OF SEDIMENTS DEPOSITED IN A DELTAIC-FLUVIAL-LAIN ENVIRONMENT. AN INTERLACING CHANNEL SYSTEM WAS WELL DEVELOPED IN THE AREA DURING COCKFIELD AND YEGUA TIME THAT IS THOUGHT TO BE THE RECORD OF THE ANCESTRAL MISSISSIPPI AND TRINITY RIVER SYSTEMS. SAND PERCENTAGE AND MAXIMUM SAND-UNIT THICKNESS SUGGEST THAT AN ALONGSHORE AND NEARSHORE ENVIRONMENT OF DEPOSITION WAS PREDOMINANT. THE COEFFICIENT OF PERMEABILITY INCREASES WITH INCREASE IN THICKNESS OF THE SAND BODY. AS A CONSEQUENCE OF THIS RELATION BETWEEN PERMEABILITY AND THICKNESS, THE AREAS OF GREATER TRANSMISSIBILITY ARE FOUND ALONG CHANNEL PATHS WHERE THICK SAND UNITS WERE DEPOSITED. THE DIRECTION OF FLOW OF WATER IS TOWARD THE GULF COAST GEOSYNCLINE AND THE MISSISSIPPI RIVER ALLUVIAL VALLEY, THE TWO PRINCIPAL AREAS OF DISCHARGE. THE

WATER IN AND NEAR OUTCROPS CONTAINS APPRECIABLE AMOUNTS OF CALCIUM AND MAGNESIUM. DIFFERENCES IN LITHOLOGIC DISTRIBUTION AND OF ALTITUDE OF THE PIEZOMETRIC SURFACES ARE VIVIDLY REFLECTED IN THE REGIONAL DISTRIBUTION OF THE DISSOLVED-SOLIDS CONTENT OF WATERS. (KNAPP-USGS)

GEOHYDROLOGIC SIGNIFICANE OF LITHOFACIES OF THE CARRIZO SAND OF ARKANSAS, LOUISIANA, AND TEXAS AND THE MERIDIAN SAND OF MISSISSIPPI

PAYNE, J. N.

GEOLOGICAL SURVEY, BATON ROUGE, LA.

AVAILABLE FROM SUPT. OF DOCUMENTS, GPO WASH., D.C. 20402, PRICE $11.00. GEOLOGICAL SURVEY PROFESSIONAL PAPER 569-D, 1975. 11 P, 2 FIG, 9 PLATES, 1 TAB, 60 REF.,

Journal Announcement: SWRA0915

THE STUDY OF THE CARRIZO AND MERIDIAN SANDS IS THE FOURTH PART OF AN INVESTIGATION OF THE GEOHYDROLOGY OF THE CLAIBORNE GROUP. THE REGIONAL DIP OF THE CARRIZO AND MERIDIAN SANDS IS INTO THE DESHA BASIN, MISSISSIPPI EMBAYMENT, AND GULF COAST GEOSYNCLINE. SOME MOVEMENT OF MAJOR STRUCTURAL FEATURES TOOK PLACE DURING CARRIZO AND MERIDIAN TIME. NORMAL FAULTING IS RATHER EXTENSIVE IN SOUTHERN ARKANSAS AND IN TEXAS. THE THICKNESS OF THE CARRIZO AND MERIDIAN SANDS VARIES FROM 0 IN AREAS OF NONDEPOSITION TO A MAXIMUM OF 700-750 FEET IN DE WITT AND KARNES COUNTIES, TEX. AQUIFER TESTS INDICATE THAT THE COEFFICIENT OF PERMEABILITY INCREASES WITH INCREASE IN SAND-UNIT THICKNESS, BUT THE RANGE IN VALUES IN THE CARRIZO AND MERIDIAN SANDS IS NOT AS GREAT AS THE RANGE IN VALUES FOUND IN THE OTHER CLAIBORNE AQUIFER FORMATIONS. THE AREAS OF HIGHEST TRANSMISSIVITY OF THE FORMATIONS ARE IN WEST-CENTRAL MISSISSIPPI AND IN SOUTHERN TEXAS. IN MISSISSIPI AND TEXAS THE DOMINANT ANION IS BICARBONATE IN WATER FROM THE CARRIZO AND MERIDIAN SANDS FROM DEPTHS OF 1,700 TO MORE THAN 2,500 FEET. IN ARKANSAS AND LOUISIANA, CHLORIDE IS THE DOMINANT ANION BELOW DEPTHS OF 500-1,00 FEET. (WOODARD-USGS)

HYDROLOGIC SIGNIFICANCE OF LITHOFACIES OF THE CANE RIVER FORMATION OR EQUIVALENTS OF ARKANSAS, LOUISIANA, MISSISSIPPI, AND TEXAS

PAYNE, J. N.

GEOLOGICAL SURVEY, WASHINGTON, D.C.

AVAILABLE FROM GPO, WASHINGTON, DC 20402 - PRICE $10.90. GEOLOGICAL SURVEY PROFESSIONAL PAPER 569-C, 1972. 17 P, 4 FIG, 16 PLATE (BOUND SEPARATELY), 1 TAB, 61 REF.,

Journal Announcement: SWRA0619

THE STUDY OF THE CANE RIVER FORMATION AND ITS EQUIVALENTS IS PART OF AN INVESTIGATION OF THE GEOHYDROLOGY OF THE CLAIBORNE GROUP OF THE GULF COASTAL PLAIN. THE THICKNESS OF THE CANE RIVER FORMATION RANGES FROM 70 FEET IN LA SALLE PARISH, LA., TO 750 FEET IN THE DESHA BASIN OF ARKANSAS. THE COEFFICIENT OF PERMEABILITY PROBABLY INCREASES WITH INCREASE IN THICKNESS. RECHARGE OF THE CANE RIVER IS MAINLY

BY PRECIPITATION IN THE OUTCROP AREA, BUT A MINOR AMOUNT OF RECHARGE TAKES PLACE BY THE UPWARD MOVEMENT OF WATER FROM THE UNDERLYING MERIDIAN-UPPER WILCOX AQUIFER. REGIONAL FLOW OF WATER IS GENERALLY DOWN THE DIP. IN AND NEAR THE OUTCROP AREA, WATER FROM THE CANE RIVER FORMATION CONTAINS PROPORTIONATELY HIGH CONCENTRATIONS OF CALCIUM AND MAGNESIUM. FARTHER DOWNDIP, SODIUM IS THE DOMINANT CATION. IN MISSISSIPPI THE DOMINANT ANION IS BICARBONATE. IN ARKANSAS AND LOUISIANA THE CHLORIDE ANION OCCURS IN SIGNIFICANT PROPORTIONS. RECHARGE OF THE REKLAW AND QUEEN CITY FORMATIONS TAKES PLACE BY INFILTRATION OF PRECIPITATION IN THE OUTCROP AREA, BY INFILTRATION OF WATER FROM STREAMS, AND BY UPWARD MOVEMENT OF WATER FROM THE CARRIZO SAND. THE DISTRIBUTION OF SOLUTES REFLECTS THE EXTENT OF FLUSHING BY FRESHWATER. (KNAPP-USGS)

### RECONNAISSANCE OF THE OXYGEN BALANCE AND THE VARIATION OF SELECTED NUTRIENTS IN THE SAN ANTONIO RIVER DURING LOW FLOW

RAWSON, J.
GEOLOGICAL SURVEY, AUSTIN, TEX.
TEXAS WATER DEVELOPMENT BOARD REPORT 142, FEBRUARY 1972. 11 P, 8 FIG, 2 TAB, 1 REF.,
Journal Announcement: SWRA0518

A WATER-QUALITY RECONNAISSANCE OF THE SAN ANTONIO RIVER IN TEXAS WAS MADE TO DESCRIBE THE PROGRESS OF WASTE ASSIMILATION, TO DELINEATE THE CRITICAL REACH OF THE RIVER (THE REACH IN WHICH THE MINIMUM DISSOLVED-OXYGEN CONCENTRATION OCCURS), AND TO DETERMINE THE CONCENTRATIONS OF SELECTED NUTRIENTS IN THE RIVER DURING THE LOW-FLOW PERIOD JUNE 16-19, 1969. WATER-QUALITY AND DISCHARGE DATA WERE OBTAINED AT SEVEN SITES IN THE 136.5-MILE REACH OF THE RIVER BETWEEN FARM ROAD 1518 NEAR ELMENDORF AND GOLIAD. THE MEAN DISCHARGE RANGED FROM 128 CFS NEAR ELMENDORF CONSISTED OF TREATED SEWAGE EFFLUENT. THE QUANTITY OF TREATED EFFLUENT RELEASED INTO THE SAN ANTONIO RIVER ABOUT 18 MILES UPSTREAM FROM THE SITE NEAR ELMENDORF RANGED FROM 46 TO 138 CFS AND AVERAGED ABOUT 100 CFS. THE TIME-WEIGHTED CONCENTRATION OF DISSOLVED OXYGEN AND THE DISSOLVED-OXYGEN DEFICIT, DURING THE PERIOD FROM 1200 HOURS ON JUNE 17 TO 1400 HOURS ON JUNE 19, SHOW THAT THE CRITICAL PART OF THE REACH EXTENDED FROM SITE 1 (MILE 203.0) TO SITE 2 (MILE 175.5). THE DISSOLVED-OXYGEN CONTENT OF WATER IN THIS 27.5-MILE REACH

### Effects of the Rate of Releases From Sam Rayburn Reservoir on the Aeration Capacity of the Angelina River, Eastern Texas

Rawson, J.; Goss, R. L.; Rathbun, I. G.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A094 303, Price codes: A03 in paper

copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-58, July, 1980. 23 p, 4 Fig, 5 Tab, 3 Ref.,

Journal Announcement: SWRA1414

A three-phase study was conducted during July and August 1979 to determine the effects of varying release rates through the power-outlet works at Sam Rayburn Reservoir, eastern Texas, on aeration capacity of a 14-mile reach of the Angelina River below Sam Rayburn Dam. The dominant factors that affected the aeration capacity during the study time were time of travel and the dissolved-oxygen deficit of the releases. Aeration was low throughout the study but increased in response to increases in the dissolved-oxygen deficit and the duration of time that the releases were exposed to the atmosphere (time of travel). The average concentration of dissolved oxygen sustained by release of 8,800 cubic feet per second decreased from 5.0 milligrams per liter at a site near the power outlet to 4.8 milligrams per liter at a site about 14 miles downstream; the time of travel averaged about 8 hours. The average concentration of dissolved oxygen in flow sustained by releases of 2,200 cubic feet per second increased from 5.2 to 5.5 milligrams per liter; the time of travel averaged about 20 hours. (USGS)

RECONNAISSANCE OF THE CHEMICAL QUALITY OF SURFACE WATERS OF THE SAN ANTONIO RIVER BASIN, TEXAS

RAWSON, JACK

GEOLOGICAL SURVEY, AUSTIN, TEX.

TEX WATER DEVELOP BOARD REP NO 93, APR 1969. 24 P, 9 FIG, 6 TAB, 25 REF.,

Journal Announcement: SWRA0219

THE KINDS AND QUANTITIES OF MINERALS DISSOLVED IN SURFACE WATERS OF THE SAN ANTONIO RIVER BASIN ARE RELATED PRINCIPALLY TO THE GEOLOGY OF THE AREA AND TO RAINFALL AND STREAMFLOW CHARACTERISTICS. MUNICIPAL AND INDUSTRIAL WASTES HAVE DEGRADED THE NATURAL QUALITY OF WATER IN SOME STREAMS. ROCKS EXPOSED IN THE BASIN RANGE IN AGE FROM CRETACEOUS TO QUATERNARY. THE UPPER PART OF THE BASIN IS UNDERLAIN BY THE EDWARDS AND ASSOCIATED LIMESTONES AND GLEN ROSE LIMESTONE. STREAMS THAT TRAVERSE THESE OUTCROPS USUALLY CONTAIN CONSTITUENTS ARE CALCIUM AND BICARBONATE. DISSOLVED-SOLIDS CONTENT OF WATER MUNICIPAL AND INDUSTRIAL POLLUTION. THE CHEMICAL COMPOSITION OF WATER IN STREAMS THAT TRAVERSE YOUNGER FORMATIONS IN THE CENTRAL AND LOWER PART OF THE BASIN IS VARIABLE. HOWEVER, THE DISSOLVED-SOLIDS CONTENT OF MOST WATER IN THESE STREAMS USUALLY IS MODERATELY HARD. ALTHOUGH THE CHEMICAL QUALITY OF WATER IN THE MAINSTEM SAN ANTONIO RIVER AND THE LOWER REACH OF CIBOLO CREEK IS BEING DEGRADED BY MUNICIPAL, INDUSTRIAL, AND IRRIGATION WASTES, THE DISCHARGE-WEIGHTED CONCENTRATION OF DISSOLVED SOLIDS IN BOTH HARD. THE CHLORIDE CONTENT OF SURFACE WATERS IN THE BASIN GENERALLY BEING DEGRADED CONSIDERABLY BY POLLUTION. THE CONCENTRATION OF CHEMICAL CONSTITUENTS IN SURFACE WATERS THROUGHOUT MUCH OF THE BASIN

IS WITHIN LIMITS RECOMMENDED BY THE U.S. PUBLIC HEALTH SERVICE FOR DOMESTIC USE. THE WATERS ALSO ARE SUITABLE FOR MOST IRRIGATION USES; HOWEVER, THE WATER THROUGHOUT MUCH OF THE BASIN IS MODERATELY HARD OR VERY HARD AND WILL REQUIRE SOFTENING FOR MOST INDUSTRIAL USES. (KNAPP-USGS)

RECONNAISSANCE OF WATER TEMPERATURE OF SELECTED STREAMS IN SOUTHEASTERN TEXAS
RAWSON, JACK
GEOLOGICAL SURVEY, AUSTIN, TEX.
TEXAS WATER DEVELOPMENT BOARD REPORT 105, JANUARY 1970. 13 P, 4 FIG, 2 TAB, 5 REF.,
Journal Announcement: SWRA0316

TEMPERATURE-PROFILE MEASUREMENTS WERE MADE AT 61 CROSS SECTIONS OF 7 MAJOR STREAMS IN TEXAS. NO CROSS-SECTIONAL VARIATIONS OF TEMPERATURE WERE OBSERVED DURING 147 MEASUREMENTS. ONLY 34 MEASUREMENTS SHOWED A TEMPERATURE DIFFERENCE OF MORE THAN 0.5 DEG C WITHIN A CROSS SECTION; THE MAXIMUM DIFFERENCE ENCOUNTERED WAS 1.5 DEG C. THEREFORE, POINT-TEMPERATURE RECORDS REPORTED BY THE U.S. GEOLOGICAL SURVEY IN TEXAS ARE USUALLY REPRESENTATIVE OF THE AVERAGE TEMPERATURE OF WATER WITHIN THE STREAM CROSS SECTION. AIR TEMPERATURE IS A REASONABLE INDEX OF THE TEMPERATURE OF THE MAJOR STREAMS IN THE STATE--PROVIDED THAT TEMPERATURE IS NOT AFFECTED BY SUCH ARTIFICIAL INFLUENCES AS ADDITION OF TREATED WASTES OR PRESENCE OF IMPOUNDMENTS. AT 8 SITES WHERE ARTIFICIAL INFLUENCE WAS NOT SIGNIFICANT, THE MEAN MONTHLY WATER TEMPERATURES, AS COMPUTED FROM ONCE-DAILY OBSERVATIONS, SELDOM DIFFERED FROM CORRESPONDING MEAN MONTHLY AIR TEMPERATURES BY MORE THAN 2 DEG C AND OFTEN DIFFERED BY NO MORE THAN 1 DEG C. THE TEMPERATURES OF TEXAS STREAMS VARY WIDELY FROM MONTH TO MONTH. THE SPREAD BETWEEN OBSERVED MONTHLY MAXIMUM AND MINIMUM TEMPERATURES AVERAGES 3-6 DEG C. (KNAPP-USGS)

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR CALAVERAS CREEK, SAN ANTONIO RIVER BASIN, TEXAS, 1970
REDDY, D. R.
GEOLOGICAL SURVEY, AUSTIN, TEX. WATER RESOURCES DIV.
GEOLOGICAL SURVEY DATA REPORT, NOVEMBER 1971. 63 P, 2 FIG, 3 TAB.,
Journal Announcement: SWRA0510

RAINFALL, RUNOFF, AND STORAGE DATA COLLECTED DURING THE 1970 WATER YEAR ARE PRESENTED FOR THE 77.2-SQUARE-MILE AREA ABOVE THE STREAM-GAGING STATION CALAVERAS CREEK NEAR ELMENDORF, TEXAS. THERE ARE 7 FLOODWATER-RETARDING STRUCTURES IN THE WATERSHED. THESE STRUCTURES HAVE A CAPACITY FOR TEMPORARY STORAGE OF 8,640 ACRE-FEET OF FLOOD RUNOFF FROM 26.6 OF THE 77.2-SQUARE-MILE STUDY AREA. THE MEAN RAINFALL IN THE STUDY AREA FOR THE 1970 WATER YEAR WAS 29.64 INCHES. THE AVERAGE MONTHLY RAINFALL TOTALS RANGED FROM 0.42 INCH IN JUNE TO 7.74 INCHES IN MAY. YEARLY MEAN DISCHARGE AT THE STREAM-GAGING STATION, CALAVERAS CREEK NEAR ELMENDORF, WAS 0.59 CFS. THIS

SHOWS THE EFFECT OF CALAVERAS DAM ON THE BASIN AS THE AVERAGE DISCHARGE FOR THE 14 YEARS (1955-68) WAS 10.7 CFS. FOR THE 1970 WATER YEAR, 6 STORMS WERE SELECTED FOR DETAILED COMPUTATIONS. THE COMPUTATIONS INCLUDE DETAILED TIME BREAKDOWN OF RAINFALL AND DISCHARGE. HYDROGRAPHS AND MASS CURVES ARE INCLUDED. (WOODARD-USGS)

QUANTITY AND CHEMICAL QUALITY OF LOW FLOW IN CIBOLO CREEK, TEXAS, MARCH 4-8, 1968
REEVES, WILLIAM E.; KUNZE, HARVEY L.
GEOLOGICAL SURVEY, AUSTIN, TEX.
TEXAS WATER DEVELOPMENT BOARD REPORT 112, APRIL 1970. 16 P, 3 FIG, 3 TAB, 4 REF.,
Journal Announcement: SWRA0320
THE CHANGES IN QUANTITY AND INORGANIC CHEMICAL QUALITY OF BASE FLOW OF CIBOLO CREEK, TEXAS, IN THE REACH FROM THE STREAM-GAGING STATION AT MILE 89.6, DOWNSTREAM TO A POINT 2.5 MILES UPSTREAM FROM THE MOUTH ARE EVAPOTRANSPIRATION WAS AT A MINIMUM. DISCHARGE INCREASED IN A DOWNSTREAM DIRECTION, FROM NO FLOW AT ABOUT MILE 88 TO 67.4 CFS AT MILE 2.5. DISSOLVED-SOLIDS CONCENTRATIONS ALSO INCREASED IN A DOWNSTREAM DIRECTION THROUGHOUT THE REACH. (KNAPP-USGS)

GROUNDWATER RESOURCES OF WASHINGTON COUNTY, TEXAS
SANDEEN, W. M.
GEOLOGICAL SURVEY, AUSTIN, TEX.
TEXAS WATER DEVELOPMENT BOARD, AUSTIN, REPORT 162, NOVEMBER 1972. 105 P, 21 FIG, 9 TAB, 52 REF.,
Journal Announcement: SWRA0614
LARGE QUANTITIES OF UNDEVELOPED FRESH WATER, EXTENDING TO DEPTHS OF 1,200 FEET BELOW SEA LEVEL OCCUR IN THE CATAHOULA SANDSTONE, JASPAR AQUIFER, EVANGELINE AQUIFER, AND THE ALLUVIUM OF THE BRAZOS RIVER IN TEXAS. IN 1968, AN ESTIMATED 3.2 MGD WAS PUMPED FROM THE GROUNDWATER RESERVOIR. AT LEASE 8,500 ACRE-FEET PER YEAR OF FRESH GROUNDWATER IS BEING TRANSMITTED THROUGH THE CATAHOULA SANDSTONE, THE JASPAR AQUIFER, AND THE EVANGELINE AQUIFER, AND ABOUT 18,700 ACRE-FEET PER YEAR OF FRESH GROUNDWATER IS BEING REJECTED FROM THE OUTCROPS OF THESE UNITS. ABOUT 30,700 ACRE-FEET PER YEAR OF FRESH GROUNDWATER PROBABLY COULD BE WITHDRAWN CONTINUOUSLY FROM THE AQUIFERS. ABOUT 118,000 ACRE-FEET PER YEAR IS AVAILABLE FOR DEVELOPMENT FROM THE ALLUVIUM OF THE BRAZOS RIVER. THE CHEMICAL QUALITY OF THE GROUNDWATER IS SUITABLE FOR MOST TYPES OF USES OR CAN BE MADE SUITABLE WITH A MINIMUM OF TREATMENT. LESS THAN 10 PERCENT OF THE SAMPLES ANALYZED FOR DISSOLVED (WOODARD-USGS)

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR ELM FORK TRINITY RIVER, TRINITY RIVER BASIN, TEXAS, 1970
SANSOM, J. N.

GEOLOGICAL SURVEY, AUSTIN, TEX.

GEOLOGICAL SURVEY OPEN-FILE REPORT (TEXAS DISTRICT), MARCH 1972. 47 P, 2 FIG, 3 TAB, APPEND.,

Journal Announcement: SWRA0518

THIS IS THE ELEVENTH IN A SERIES OF BASIC-DATA REPORTS PUBLISHED ANNUALLY FOR THE ELM FORK TRINITY RIVER STUDY AREA, AND CONTAINS THE RAINFALL, RUNOFF, AND STORAGE DATA COLLECTED DURING THE 1970 WATER YEAR FOR THE 46.0-SQUARE-MILE AREA ABOVE THE STREAM-GAGING STATION ELM FORK TRINITY RIVER NEAR MUENSTER, TEXAS. FOURTEEN FLOODWATER RETAINING STRUCTURES PROVIDE CAPACITY FOR FLOOD-DETENTION STORAGE OF 10,500 ACRE-FEET OF FLOOD RUNOFF FROM 33.5 SQUARE MILES OF THE 46.0-SQUARE-MILE DRAINAGE AREA. THE AVERAGE RAINFALL FOR THE 1970 WATER YEAR WAS 35.16 INCHES, OR 103% OF THE 14-YEAR (1957-70) AVERAGE. THE MONTHLY RAINFALL TOTALS RANGED FROM A LOW OF 0.31 INCHES IN JANUARY TO A HIGH OF 8.43 INCHES IN SEPTEMBER. YEARLY MEAN DISCHARGE AT THE STREAM-GAGING STATION WAS 20.5 CFS, COMPARED WITH THE 14-YEAR (1957-70) AVERAGE OF 20.1 CFS. TOTAL RUNOFF DURING THE YEAR WAS 14.860 ACRE-FEET (6.06 INCHES), WHICH IS 17% OF THE TOTAL RAINFALL. FOUR STORM PERIODS WERE SELECTED FOR DETAILED RAINFALL AND DISCHARGE COMPUTATIONS. (WOODARD-USGS)

### SELECTED HYDROLOGIC CHARACTERISTICS OF THE SABINE RIVER AND BAYOU ANACOCO, LOUISIANA AND TEXAS

SHAMPINE, WILLIAM J.

GEOLOGICAL SURVEY, BATON ROUGE, LA.

GEOLOGICAL SURVEY - SABINE RIVER COMPACT ADMINISTRATION COOPERATIVE REPORT, 1971. 34 P, 18 FIG, 1 PLATE, 1 TAB, 6 REF.,

Journal Announcement: SWRA0419

CREATION OF TOLEDO BEND RESERVOIR (TEXAS-LOUSIANA) HAS CAUSED SIGNIFICANT CHANGES IN THE CHARACTERISTICS OF SABINE RIVER FLOODS ORIGINATING IN THE IMMEDIATE VICINITY OF THE RESERVOIR. A FLOOD WITH A 20-YEAR RECURRENCE INTERVAL WILL NECESSITATE A CONSTANT RELEASE OF 50,000 CFS FOR 4 DAYS TO MAINTAIN A LAKE LEVEL ELEVATION LESS THAN 173.5 FEET WHEN THE INITIAL ELEVATION IS 170 FEET. OXYGEN DEPLETION IN THE HYPOLIMNION DURING THE SUMMER CAUSES SEVERAL WATER-QUALITY PROBLEMS IN TOLEDO BEND RESERVOIR. THE CONCENTRATION OF ANY SOLUBLE CONTAMINANT SPILLED INTO BAYOU ANACOCO FROM ROSEPINE, LA. TO THE MOUTH CAN BE CALCULATED. IF 1,000 POUNDS OF A CONTAMINANT WERE DUMPED INTO BAYOU ANACOCO AT MILE 20 WHEN THE DISCHARGE AT THE POINT WAS 150 CFS, THE MAXIMUM CONCENTRATION THAT WOULD REACH THE MOUTH (WOODARD-USGS)

### SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES--RIO GRANDE REGION

WEST, S. W.; BROADHURST, W. L.

GEOLOGICAL SURVEY, RESTON, VA.

AVAILABLE FROM SUPT. OF DOCUMENTS, GPO, WASHINGTON, D.C.

20402 - PRICE $1.75. PROFESSIONAL PAPER 813-D, 1975. 39 P, 21 FIG, 2 TAB, 154 REF.,
Journal Announcement: SWRA0821

THE RIO GRANDE IS AN INTERSTATE AND INTERNATIONAL STREAM WHICH BEGINS IN HIGH MOUNTAINS OF COLORADO, FLOWS ACROSS NEW MEXICO, AND FORMS THE BOUNDARY BETWEEN TEXAS AND MEXICO. ANNUAL PRECIPITATION ON THE REGION IS ABOUT 86 MILLION ACRE-FEET; HOWEVER, ALL BUT 4 MILLION ACRE-FEET IS RETURNED TO THE ATMOSPHERE BY EVAPOTRANSPIRATION. THE GROUNDWATER RESERVOIRS CONTAIN AN AGGREGATE OF 5,800 MILLION ACRE-FEET OF FRESH AND SLIGHTLY SALINE WATER IN STORAGE, WHICH COULD BE WITHDRAWN THROUGH WELLS. IN CONTRAST, THE SURFACE RESERVOIRS HAVE A COMBINED STORAGE CAPACITY OF ONLY 18 MILLION ACRE-FEET. WITHDRAWAL OF GROUNDWATER IN 1970 WAS 2.7 MILLION ACRE-FEET, OF WHICH 88% WAS USED FOR IRRIGATION. THE REGION APPEARS TO OFFER SEVERAL POSSIBILITIES FOR UTILIZING UNDERGROUND SPACE FOR PURPOSES OTHER THAN THE WITHDRAWAL OF WATER, SUCH AS WASTE DISPOSAL, ARTIFICIAL RECHARGE, WATER-QUALITY CONTROL, AND DEVELOPMENT OF GEOTHERMAL ENERGY. (WOODARD-USGS)

GROUND-WATER RESOURCES OF RAINS AND VAN ZANDT COUNTIES, TEXAS
WHITE, D. E.
GEOLOGICAL SURVEY, AUSTIN, TEX.
TEXAS WATER DEVELOPMENT BOARD REPORT 169, APRIL 1973. 81 P, 26 FIG, 6 TAB, 35 REF.,
Journal Announcement: SWRA0619

RAINS AND VAN ZANDT COUNTIES IN NORTHEAST TEXAS HAVE ABUNDANT WATER RESOURCES AND COMPARATIVELY LITTLE WATER DEMAND. THE WATER IS DERIVED FROM THE HEAVY PRECIPITATION (ABOUT 43 INCHES ANNUALLY) WHICH FILLS THE NUMEROUS LAKES AND RESERVOIRS AND RECHARGES THE FRESHWATER AQUIFERS. ONE OF THE AQUIFERS IN THE AREA, THE CARRIZO-WILCOX, HAS BEEN APPRECIABLY DEVELOPED. DURING 1969, THIS AQUIFER SUPPLIED A REPORTED 1,500 ACRE-FEET OF WATER FOR MUNICIPAL SUPPLY, INDUSTRIAL USE, AND RURAL WATER SYSTEMS IN THE TWO COUNTIES. THE CARRIZO-WILCOX AQUIFER CONTAINS AN ESTIMATED 50 MILLION ACRE-FEET OF FRESH TO SLIGHTLY SALINE WATER IN STORAGE. ABOUT 10% OF THIS AMOUNT, OR 5 MILLION ACRE-FEET, IS AVAILABLE TO WELLS. IN ADDITION TO THE WATER IN STORAGE, THE CARRIZO-WILCOX AQUIFER ANNUALLY RECEIVES AN ESTIMATED 5,000 ACRE-FEET OF EFFECTIVE RECHARGE FROM PRECIPITATION. YIELDS OF WELLS TAPPING THE CARRIZO-WILCOX AQUIFER RANGE FROM LESS THAN 5 TO AS MUCH AS 600 GPM. MOST OF THE MUNICIPAL AND INDUSTRIAL WELLS ARE EQUIPPED TO PUMP AT RATES OF 100 TO 250 GPM. A SECOND AQUIFER, THE QUEEN CITY SAND, IN SOUTHEASTERN VAN ZANDT COUNTY, WHICH IS CURRENTLY TAPPED SOLELY FOR RURAL DOMESTIC AND LIVESTOCK SUPPLY, IS PROBABLY CAPABLE OF YIELDING AS MUCH AS 150 GPM OF FRESHWATER TO PROPERLY CONSTRUCTED WELLS. (WOODARD-USGS)

Groundwater Data for the Salt Basin, Eagle Flat, Red Light Draw, Green River Valley, and Presidio Bolson in Westernmost

Texas
White, D. E.; Gates, J. S.; Smith, J. T.; Fry, B. J.
Geological Survey, Austin, TX. Water Resources Div.
Open-file report 77-575, March 1978. 120 p, 8 fig, 3 tab, 5 ref.,
Journal Announcement: SWRA1122

From October 1971 through October 1974, the U.S. Geological Survey collected groundwater data in the basins in Texas west of the Pecos River drainage area and northwest of the Big Bend country. The basins included are, from east to west: The Presidio Bolson; the Salt Basin; Green River Valley, Eagle Flat, and Red Light Draw. The data collection program consisted of an inventory of all major irrigation, municipal-supply, and industrial wells; selected stock and domestic wells; and selected springs. Water samples were collected from representative wells and springs for chemical analyses. (Woodard-USGS)

Camp Swift Coal Leasing, Texas
BLM, Santa Fe, New Mexico
FEIS, 1980

The proposed action is to lease 6,600 acres for surface coal mining in Bastrop County, southeast-central Texas. Underlying the area are 80-100 million tons of surface minable coal in the Calvert Bluff Formation of the Wilcox Group. The area is drained by intermittent McLaughlin and Dogwood Creeks, tributary to Big Sandy Creek adjacent on the northwest. The Calvert Bluff Formation overlies the Simsboro Formation, also Wilcox Group, and underlies the Carrizo Formation, both being significant aquifers. Highwall seepage from lensatic sandstones in the Calvert Bluff Formation is estimated to be about 160 gallons per minute (worst case). Dewatering of the underlying Simsboro Formation by wells at 10,600 gallons per minute (also worst case) would be required for hydrostatic pressure relief. Discharge of this water into Big Sandy Creek would increase base flow by 23 times, and median flow 4.5 times. Erosion of the streambed would be significant during mining, but the creek would gradually return to premining conditions. Dewatering would cause a drawdown of 81 feet at the nearest well, 2 miles down gradient, and increase its pumping lift.

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RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE UPPER FREMONT RIVER VALLEY, WAYNE COUNTY, UTAH

BJORKLUND, L. J.

GEOLOGICAL SURVEY, LOGAN, UTAH.

COPIES OF REPORT AVAILABLE AT UTAH DEPT OF NATURAL RESOURCES, DIV OF WATER RIGHTS, 442 STATE CAPITOL, SALT LAKE CITY, UTAH. TECHNICAL PUBLICATION NO 22, 1969. 54 P, 11 FIG, 6 TAB, 21 REF.,

Journal Announcement: SWRA0313

THE UPPER FREMONT RIVER VALLEY, A DEPRESSION CAUSED BY FAULTING, ALTERED BY EROSION, AND PARTLY FILLED BY ALLUVIUM ERODED FROM SURROUNDING HIGHLANDS, INCLUDES ABOUT 40 SQUARE MILES IN SOUTH-CENTRAL UTAH. THE DRAINAGE BASIN WHICH CONTRIBUTES WATER TO THE VALLEY INCLUDES ABOUT 700 SQUARE MILES. WATER DRAINS TO THE VALLEY FROM SEVERAL HIGH PLATEAUS. SEDIMENTARY ROCKS OF TRIASSIC, JURASSIC, TERTIARY, AND QUATERNARY AGE AND VOLCANIC ROCKS OF TERTIARY AGE ARE EXPOSED IN THE AREA. THE TERTIARY VOLCANIC ROCKS YIELD WATER TO SEVERAL LARGE SPRINGS AND FLOWING WELLS; THIS UNIT IS THE PRINCIPAL SOURCE OF GROUNDWATER IN THE VALLEY. THE VALLEY FILL OF QUATERNARY AGE, WHICH IS MORE THAN 500 FEET THICK IN PLACES, IS ALSO AN IMPORTANT SOURCE, YIELDING WATER TO MANY WELLS. THE AVERAGE ANNUAL INFLOW TO THE VALLEY VIA THE FREMONT RIVER DURING 1950-57 WAS 29,120 ACRE-FEET AND THE AVERAGE ANNUAL OUTFLOW DURING 1909-57 WAS 64,840 ACRE-FEET. ABOUT 80,000 ACRE-FEET OF WATER IS DISCHARGED BY SPRINGS AND SEEPS IN THE VALLEY DURING MOST YEARS. APPROXIMATELY 3,500 ACRE-FEET OF WATER IS DISCHARGED FROM FLOWING WELLS AND ABOUT 700 ACRE-FEET IS PUMPED FROM WELLS DURING A YEAR. IRRIGATION IS THE PRINCIPAL USE OF BOTH SURFACE AND GROUNDWATER IN THE VALLEY. GROUNDWATER IS USED ALSO FOR THE PUBLIC SUPPLIES OF FREMONT, LOA, LYMAN, AND BICKNELL, FOR DOMESTIC AND STOCK USE, AND FOR FISH CULTURE. THE GROUNDWATER IN THE VALLEY IS SUITABLE FOR MOST USES. (KNAPP-USGS)

SALT-LOAD COMPUTATIONS--COLORADO RIVER; CAMEO, COLORADO, TO CISCO, UTAH: PART 2. BASIC DATA. (DUPLICATED SEE COLORADO).

BRENNAN, R.; GROZIER, R. U.

GEOLOGICAL SURVEY, DENVER, COLO.

OPEN-FILE REPORT, 1976. 222 P, 54 FIG, 12 TAB.,

Journal Announcement: SWRA0919

SALT-LOAD COMPUTATIONS--COLORADO RIVER; CAMEO, COLORADO TO CISCO, UTAH: PART 1. DATA SUMMARY. (DUPLICATED SEE COLORADO).

BRENNAN, R.; GROZIER, R. U.

GEOLOGICAL SURVEY, DENVER, COLO.

OPEN-FILE REPORT, 1976. 15 P, 3 FIG, 6 TAB.,

Journal Announcement: SWRA0919

Hydrologic and Climatologic Data, Southeastern Uinta Basin, Utah, and Colorado, Water Year 1978

Conroy, L. S.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $21.25 in paper copy, $5.50 in microfiche. Geological Survey Open-File Report 80-1025, 1980. 166 p, 6 Fig, 8 Tab, 2 Ref.,

Journal Announcement: SWRA1414

This report contains data collected in the vicinity of the oil-shale area in the southeastern Uinta Basin, Utah and Colorado, from Oct. 1, 1977, to Sept. 30, 1978. The data presented in tables, include monthly precipitation, depth-duration of rainfall, snow depth and water content, air temperature, daily streamflow records, water-quality data from continuous-recording gaging sites, water-quality data for wells and springs, and water levels, temperature, and specific conductance for selected wells. (USGS)

Climatologic and Hydrologic Data, Southeastern Uinta Basin, Utah and Colorado, Water Years 1975 and 1976

Conroy, L. S.; Fields, F. K.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Utah Basic-Data Release No. 29, 1977. 244 p, 5 fig, 10 tab.,

Journal Announcement: SWRA1117

Climatologic and hydrologic data were collected as a part of an investigation of the southeastern Uinta Basin, Utah and Colorado, by the U.S. Geological Survey. The data apply mainly to water years 1975 and 1976, which includes the period from October 1974 through September 1976. Included also are some earlier ground-water data not previously published. The data, presented in tables, include monthly precipitation, snow depth, monthly pan evaporation, soil moisture, daily streamflow records, water-quality data from continuous-recording gaging sites, discharge and water-quality data at partial-record streamflow gaging sites; and discharge, temperature, and water-quality data for wells and springs, and water levels in selected wells. (Woodard-USGS)

Ground-water conditions in the upper Virgin River and Kanab Creek basins area, Utah, with emphasis on the Navajo Sandstone.

Cordova, R. M., 1980

U.S. Geological Survey Open-File Report 80-524, 99 p. (to be duplicated as Utah Department of Natural Resources Technical Publication 70).

The Navajo Sandstone of Triassic(?) and Jurassic age, the most important bedrock aquifer in the area, was estimated to contain 200 million acre-ft of recoverable water. Aquifers occur in geologic units other than the Navajo, including coal-bearing rocks of Cretaceous age. It was concluded that water enters the aquifers by infiltration of precipitation and seepage from streams in the headwaters of the Virgin River and Kanab Creek. Potentiometric-surface data indicated that water moved from areas of recharge generally southward toward areas of natural discharge in the lower reaches of major streams. Chemical quality of ground water was found to vary both areally and by geologic source. The hydrologic impacts of possible increased ground-water withdrawals for the development of coal are evaluated.

Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone

Cordova, R. M.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Available from Utah Dept. of Natural Res. Div. of Water Rights 231 East 400 South Salt Lake City, Utah 84111. Utah Department of Natural Resources Technical Publication No 70, 1981. 87 p, 18 Fig, 3 Plates, 23 Tab, 30 Ref.,

Journal Announcement: SWRA1510

The upper Virgin River and Kanab Creek basins area in south-central Utah includes about 1,300 square miles in the upper Virgin River basin and about 650 square miles in the upper Kanab Creek basin. The sparsely populated area contains large coal reserves. Water occurs in both the unconsolidated and consolidated rocks. Principal aquifers in the unconsolidated rocks include older stream-channel deposits, lower parts of alluvial fans, and stream-valley alluvium. The most important consolidated-rock aquifer is the Navajo Sandstone of Triassic and Jurassic age. Other consolidated-rock aquifers of note include the Shinarump Member of the Chinle Formation of Triassic age, sandstone strata of Cretaceous age, and the Wasatch Formation of Tertiary age. Groundwater recharge is derived chiefly from precipitation on the area and is estimated to average about 80,000 acre-feet per year. Discharge occurs chiefly as seepage to lower stream reaches and evapotranspiration; natural discharge is estimated to total at least 62,700 acre-feet per year. In addition, about 5,000 acre-feet per year discharges as underflow into Arizona; and in 1977, at least 3,300 acre-feet was withdrawn by wells. Chemical quality of ground water varies considerably with geologic source. Water in the Navajo Sandstone and Wasatch Formation most places. Water in the Chinle and Moenkopi Formations of Triassic age and the Carmel Formation of Jurassic age is generally saline, containing 1,000 to 3,000 mg/L of dissolved solids in most places. (USGS)

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1968

CORDOVA, R. M.; BJORKLUND, L. J.; BUTLER, R. G.; MOWER, R. W.; HERBERT, L. R.

GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.

UTAH DIV WATER RESOURCES COOP INVEST REP NO 6, OCT 1968. 105 P, 56 FIG, 4 TAB, 6 REF.,

Journal Announcement: SWRA0211

THE GROUNDWATER CONDITIONS IN UTAH IN THE SPRING OF 1968 ARE COMPILED AND ANALYZED. INFORMATION IS PRESENTED ON WELL CONSTRUCTION, GROUNDWATER WITHDRAWALS, WATER-LEVEL CHANGES, AND RELATED CHANGES IN PRECIPITATION AND STREAMFLOW. GRAPHS SHOW CHEMICAL QUALITY OF WATER. MAPS SHOW WATER TABLE CONFIGURATION. MOST AREAS OF IMPORTANT GROUNDWATER WITHDRAWAL ARE DISCUSSED. AREAS OF POTENTIAL LARGE GROUNDWATER DEVELOPMENT ARE DISCUSSED AND MAPPED. LESS THAN 2% OF THE UTAH WELLS OBTAIN WATER FROM CONSOLIDATED ROCK, MOSTLY LAVA FLOWS, LIMESTONE, AND SANDSTONE. THE REMAINING 98% ARE IN GRAVEL, SAND, SILT AND CLAY IN LARGE INTERMOUNTAIN ALLUVIAL BASINS. THE ESTIMATED 1967 TOTAL WITHDRAWAL OF GROUNDWATER WAS ABOUT 650,000 ACRE-FT, 79,200 FOR IRRIGATION, 11,700 FOR INDUSTRY, AND 9,400 FOR PUBLIC SUPPLY. THE 1967 PRECIPITATION WAS 0.45-2.82 INCHES ABOVE NORMAL, AND COMBINED WITH LESS THAN USUAL WITHDRAWAL, RESULTING IN A GENERAL WATER LEVEL RISE. (KNAPP-USGS)

GROUNDWATER CONSITIONS IN THE CENTRAL VIRGIN RIVER BASIN, UTAH

CORDOVA, R. M.; SANDBERG, G. W.; MCCONKIE, W.

GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.

UTAH DEPARTMENT OF NATURAL RESOURCES, SALT LAKE CITY, TECHNICAL PUBLICATION NO 40, 1972. 64 P, 10 FIG, 3 PLATE, 18 TAB, 12 REF, 1 APPEND.,

Journal Announcement: SWRA0616

THE CENTRAL VIRGIN RIVER BASIN, IN WASHINGTON AND IRON COUNTIES, UTAH, INCLUDES ABOUT 1,000 SQUARE MILES IN THE DRAINAGE BASIN OF THE VIRGIN RIVER DOWNSTREAM FROM HURRICANE CLIFFS. AQUIFERS IN BOTH CONSOLIDATED AND UNCONSOLIDATED ROCKS SUPPLY WATER FOR PUBLIC SUPPLY, IRRIGATION, STOCK, INDUSTRY, AND DOMESTIC USES. THE CHIEF UNCONSOLIDATED-ROCK AQUIFERS ARE ALLUVIAL FANS AND CHANNEL-FILL DEPOSITS, WHICH SUPPLY ABOUT 80% OF THE WATER WITHDRAWN BY WELLS IN THE BASIN. THE CHIEF CONSOLIDATED-ROCK AQUIFERS INCLUDE THE MOENKOPI, CHINLE, MOENAVE, AND KAYENTA FORMATIONS, THE NAVAJO SANDSTONE, BASALT, AND TERTIARY IGNEOUS ROCKS OF THE PINE VALLEY MOUNTAINS. AVERAGE ANNUAL RECHARGE TO THE AQUIFERS OF THE CENTRAL VIRGIN RIVER BASIN IS ESTIMATED TO BE 100,000 ACRE-FEET. DISCHARGE FROM WELLS AVERAGED 6,600 ACRE-FEET ANNUALLY FOR THE YEARS 1968-70. WATER-LEVEL HYDROGRAPHS GIVE NO INDICATION THAT WITHDRAWALS OF GROUNDWATER TO DATE HAVE HAD ANY SIGNIFICANT EFFECT ON THE AMOUNT OF GROUNDWATER IN STORAGE. THE DISSOLVED-SOLIDS CONCENTRATION IN THE WATER DIFFERS CONSIDERABLY FROM AQUIFER TO AQUIFER AND FROM PLACE TO PLACE. THE AQUIFERS THAT ARE MOST LIKELY TO YIELD WATER CONTAINING LESS THAN 1,000 MILLIGRAMS PER LITER ARE THE NAVAJO SANDSTONE AND BASALT. THE CHINLE AND MOENKOPI FORMATIONS ARE MOST LIKELY TO YIELD WATER CONTAINING MORE THAN 3,000 MILLIGRAMS PER LITER. (WOODARD-USGS)

Hydrology of the coal-resource areas in the upper drainages of

Huntington and Cottonwood Creeks, central Utah.
Danielson, T. W., Millard, M. D., and Fuller, R. H., 1980b
U.S. Geological Survey open-file report, WRI 81-539, 85 p.

The hydrologic system in this important coal-resource area of the Wasatch Plateau is described. Data were collected from about 140 springs that issue from several water-bearing zones in rocks of Cretaceous and/or Tertiary age. Most springs that discharged more than about 50 gal/min were associated with faulting. During 1979, water entered underground coal mines mainly through joints, faults, and holes in mine roofs. Discharge from mines ranged from zero to about 1,100 gal/min.

Large differences in surface runoff in the study area are described. Chemical quality of surface water, as well as quality of water from springs and mines, is described.

Possible effects of underground coal mining and associated mine dewatering on the hydrologic system are evaluated. It was concluded that discharge-recession curves for springs showed promise as a method of detecting changes in the ground-water system caused by mining.

Hydrology of coal-resource areas in the southern Wasatch Plateau, central Utah.
Danielson, T. W., and Sylla, D. A., 1982
U.S. Geological Survey Water-Resources Investigations Open-File Report 82-4009.

Summary Appraisals of the Nation's Ground-Water Resources--Lower Colorado Region
Davidson, E. S.
Geological Survey, Tucson, AZ. Water Resources Div.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00. Geological Survey Professional Paper 813-R, 1979. 23 p, 6 Fig, 3 Plates, 3 Tab, 63 Ref.,
Journal Announcement: SWRA1318

Much of the water used in the semiarid lower Colorado River region is ground water, and pumpage is in excess of replenishment. In the southwest depth to water generally is about 200 to 500 feet below the land surface, irrigation and public-supply wells generally yield 500 to 1,500 gallons per minute, and about 1 billion acre-feet of ground water potentially is recoverable from storage. In the northeast water levels generally are more than 500 feet below the land surface, most wells yield between 10 and 500 gallons per minute, and 150 million acre-feet or possibly more could be recovered. Annual storage depletion, almost entirely in the southwest, is about 2.4 to 3.2 million acre-feet. Almost 6 million acre-feet is pumped annually, mostly for crops. Subsidence, earth cracks, increasing pumping costs, and water quality limit potential ground-water development. However, some gains can be made through changes and greater efficiencies of use and by reducing evapotranspiration. Prior use and economics determine water use in Arizona-the largest part of the region. All States except Arizona have laws that allow control and allocation of ground water by the State. (Kosco-USGS)

Some engineering geologic factors controlling coal mine subsidence in Utah and Colorado.
Dunrud, C. R., 1976
U.S. Geological Survey Professional Paper 969, 39 p.

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1975
EYCHANER, J. H.
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
UTAH DIVISION OF WATER RESOURCES, SALT LAKE CITY, COOPERATIVE INVESTIGATIONS REPORT NO 14, 1975. 26 P, 37 FIG, 2 TAB, 13 REF.,
Journal Announcement: SWRA0821

THIS REPORT IS THE TWELFTH IN A SERIES OF ANNUAL REPORTS THAT DESCRIBE GROUNDWATER CONDITIONS IN UTAH. THE REPORT INCLUDES INDIVIDUAL DISCUSSIONS OF THE MOST IMPORTANT AREAS OF GROUNDWATER WITHDRAWAL IN THE STATE FOR THE CALENDAR YEAR 1974. WATER-LEVEL FLUCTUATIONS, HOWEVER, ARE DESCRIBED FOR THE PERIOD SPRING 1974 TO SPRING 1975. THE ESTIMATED TOTAL WITHDRAWAL FROM WELLS IN 1974 WAS ABOUT 879,000 ACRE-FT WHICH WAS ABOUT 165,000 ACRE-FT MORE THAN IN 1973 AND 195,000 ACRE-FT GREATER THAN THE AVERAGE ANNUAL WITHDRAWAL FOR THE PERIOD 1964-73. BOTH THE INCREASE OVER 1973 AND THE INCREASE OVER THE 10-YEAR AVERAGE WERE DUE PRIMARILY TO CHANGES IN WITHDRAWALS FOR IRRIGATION. ESTIMATED TOTAL WITHDRAWALS FOR IRRIGATION IN 1974 WERE ABOUT 611,000 ACRE-FT, WHICH WAS ABOUT 27% MORE THAN THE 480,000 ACRE-FT WITHDRAWN IN 1973. CHANGES IN GROUNDWATER LEVELS FROM SPRING 1974 TO SPRING 1975 REFLECTED THE DECREASED AVAILABILITY OF SURFACE WATER AND THE INCREASE IN GROUNDWATER WITHDRAWALS. WATER LEVELS FELL IN MOST MAJOR GROUNDWATER BASINS IN THE STATE. PAVANT VALLEY, IN CENTRAL UTAH, WAS THE ONLY MAJOR GROUNDWATER BASIN IN WHICH WATER LEVELS WERE HIGHER IN MARCH 1975 THAN IN MARCH 1974. (WOODARD-USGS)

Ground-Water Conditions in Utah, Spring of 1978
Gates, J. S.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Utah Division of Water Resources, Salt Lake City, Div of Water Resources, Cooperative Investigations Report No 17, 1978. 63 p, 37 fig, 3 tab, 16 ref. ,
Journal Announcement: SWRA1122

This report is the fifteenth in a series of annual reports that describe ground-water conditions in Utah. The estimated total withdrawal of water from wells in Utah in 1977 was about 947,000 acre-feet, which was about 86,000 acre-feet more than in 1976 and 210,000 acre-feet greater than the average annual withdrawal for the period 1967-76. Both the increases over 1976 and the increase over the 10-year average were due primarily to increases in withdrawals for irrigation and public supply. Precipitation in 1977 was below average in most of Utah, especially during the early part of the year. The decreased availability of surface water for irrigation and below-average precipitation resulted in an increase in ground-water withdrawals for irrigation. Water levels generally declined in the major areas of ground-water development. Included is a list of ground-water reports for Utah that were released by the U.S. Geological Survey during 1977. (Woodard-USGS)

Ground-water reconnaissance in the Morgan Valley, Henefer Valley, Coalville area, Morgan and Summit Counties, Utah.
Gates, J. S., and Steiger, J. I.

Reconnaissance appraisal of the water resources of the Henry Mountains coal field, Wayne and Garfield Counties, Utah, 1975-77.
Goode, H. D., and Olson, Eric., 1977.
University of Utah Research Report, Salt Lake City, Utah. Prepared for the U.S. Department of Interior, July 1977.
Availability and quality of water are assessed. It was concluded that the Navajo Sandstone was the most probable source of large quantities of water. It was estimated that the Navajo contained about 50,000 acre-ft of ground water per square mile and that each year 20,000 to 30,000 acre-ft could be withdrawn from the Navajo in the study area with properly spaced wells. Sources of smaller quantities of water also are identified. Records of wells and springs and chemical analyses of water are listed in tables.

Preliminary hydrologic evaluation of the North Horn Mountain coal-resource area, Utah.
Graham, M. J., Tooley, J. E., and Price, Don, 1981.
U.S. Geological Survey Open-File Report 81-141, 33 p.
A generalized hydrologic description of this undeveloped coal-resource area is presented. Preliminary data indicated that most reaches of tributaries to Cottonwood and Ferron Creeks on North Horn Mountain were ephemeral and that the dissolved-solids concentration of surface water averaged less than 500 mg/L. Estimates of peak discharge (100-year flood) were made for several of the ephemeral streams. It was concluded that most ground water in North Horn Mountain probably was stored in perched aquifers overlying the coal. Numerous springs and seeps issued from the perched aquifers, but the spring waters usually were consumed by evapotranspiration short distances from the sources. It also was concluded that a regional aquifer exists in the Star Point Sandstone below the coal and sometimes in the coal-bearing Blackhawk Formation, both of Cretaceous age. Dissolved-solids concentrations of ground water ranged from less than 500 to about 1,000 mg/L. Potential impacts of coal development on the water resources are evaluated.

Ground-Water Conditions in Utah, Spring of 1981
Herbert, L. R.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Utah Division of Water Resources Cooperative Investigations Report Number 21, 1981. 75 p, 41 Fig, 3 Tab, 2 Ref.,
Journal Announcement: SWRA1424

This is the eighteenth in a series of annual reports that describe groundwater conditions in Utah. The estimated total withdrawal of water from wells in Utah in 1980 was about 762,000 acre-feet--about 98,000 acre-feet less than in 1979 and 44,000 acre-feet less than the average annual withdrawal during 1970-79. The decrease in withdrawal was due primarily to decreases in withdrawal for irrigation. Total withdrawal for irrigation in 1980 was about 494,000 acre-feet, which is 73,000 acre-feet less than reported for 1979. Withdrawal for public supply was 143,000 acre-feet, a decrease of 19,000 acre-feet. The quantities of water withdrawn from wells are closely related to local climatic conditions. Precipitation in 1980 was above average in most of Utah (National Oceanic and Atmospheric Administration, 1981). Of the 33 stations for which graphs of cumulative departure from average annual precipitation are included in this report, 1 had below-average precipitation in 1980. This contributed most significantly to decreased withdrawals from wells during 1980. The above-average precipitation in most parts of the State during 1980 resulted in increased water supplies, recharge of ground water, and water for reservoirs as well as decreased withdrawals from wells. This in turn resulted in a general rise of ground-water levels in many parts of the State from spring of 1980 to spring of 1981. Notable exceptions where declines occurred were in areas where local above-average runoff contributed greatly to the recharge of the ground-water reservoir in the spring of 1980 but was not a factor in the spring of 1981. Also, declines occurred in some areas of late-season withdrawals. The total number of wells drilled during 1980, as indicated by well-drillers reports filed with the Utah Division of Water Rights, was about 2 percent more than reported for 1979. The number of those wells 6 inches or more in diameter drilled for public supply, irrigation, and industrial use was about 18 percent less than reported for 1979. (USGS)

Ground-Water Conditions in Utah, Spring of 1980
Herbert, L. R.
Geological Survey, Salt Lake City, UT. Water Resources. Div.
Utah Division of Water Resources Cooperative Investigations Report No 19, 1980. 72 p, 39 Fig, 3 Tab, 2 Ref.,
Journal Announcement: SWRA1401

This is the seventeenth in a series of annual reports that describe groundwater conditions in Utah. The estimated total withdrawal of water from wells in Utah in 1979 was about 860,000 acre-feet--about 31,000 acre-feet more than in 1978 and 73,000 acre-feet more than the average annual withdrawal during 1969-78. The increase in withdrawal from the amount reported for 1978 was due primarily to increases in withdrawal for public supply. Total withdrawal for public supply in 1979 was about 162,000 acre-feet, which is 33,000 acre-feet more than reported for 1978. Withdrawal for irrigation was 567,000 acre-feet, an increase of 5,000 acre-feet. The quantities closely related to local climatic conditions. Precipitation in 1979 was below average in most of Utah (Natio of water withdrawn from wells are nal Oceanic and Atmospheric Administration, 1980). Of the 33 stations for which graphs of cumulative departure from average annual precipitation are included in this report, 27 had below-average precipitation in 1979. This contributed most significantly to increased withdrawals from wells during 1979. The below-average precipitation in most parts of the State during 1979 resulted in local reduction in ground-water recharge as well as increased withdrawals from wells. This in turn resulted in a general decline of ground-water levels in many parts of the State from spring of 1979 to spring of 1980. Notable exceptions where rises occurred were in areas where local above-average runoff contributed greatly to the recharge of the groundwater reservoir. The total number of wells drilled during 1979, as indicated by well-drillers' reports filed with the Utah Division of Water Rights, was about 35 percent less than reported for 1978. The number of those wells 6 inches or more in diameter drilled for public supply irrigation, and industrial use was about 28 percent less than reported for 1978. (USGS)

Ground-Water conditions in Utah, Spring of 1982
Holmes, W. F., and Others, 1982
Utah Division of Water Resources Cooperative Investigations Report No.22

Hydrologic Evaluation of Ashley Valley, Northern Uinta Basin Area, Utah
Hood, J. W.
Geological Survey, Salt Lake City, Utah. Water Resources Div.
Utah Department of Natural Resources Technical Publication No 54, 1977. 25 p, 3 fig, 1 plate, 6 ref.,
Journal Announcement: SWRA1021

The water resources of the northern Uinta Basin, Utah and Colorado, were studied during 1971-74. Ashley Valley was evaluated in slightly greater detail than the general area, in order to assess the general relation of ground- and surface-water supplies. In Ashley Valley, the principal source of both irrigation supply and ground-water recharge is the flow from Ashley Creek canyon. Ground-water recharge to the valley fill, however, is mainly from canal and field losses along the west side of the valley. The permeability of the fill in most places is high, and water-level records indicate rapid changes in storage in response to the annual applications of irrigation water. The amount of ground water available from storage in Ashley Valley is estimated to be 50,000-75,000 acre-feet, or enough water to supply irrigation in the vally for a maximum of 2 years. The water from Ashley Creek canyon is fresh. Mixing of snowmelt and base flow in Steinaker Reservoir yields a water of more uniform quality; but despite some concentration by evaporation from the reservoir, the outflow from the reservoir is fresh. Ground water in most of the valley is fresh, but the water increases in dissolved-solids concentration toward the south and east. (Woodard-USGS)

Hydrologic Evaluation of the Upper Duchesne River Valley, Northern Uinta Basin Area, Utah
Hood, J. W.
Geological Survey, Salt Lake City, Utah. Water Resources Div.
Utah Department of Natural Resources, Salt Lake City, Technical Publication No 57, 1977. 34 p, 5 fig, 2 plates, 3 tab, 12 ref.,
Journal Announcement: SWRA1023

The upper Duchesne River valley was studied during 1971-74 as part of an investigation of the northern Uinta Basin area, Utah and Colorado. This report describes the relation of ground water to surface water in the upper Duchesne River valley, estimates the quantity of ground water that moves to the Duchesne River, and evaluates the probable effect of increased ground-water withdrawals on the stream regimen. The primary source of water is precipitation on the highlands adjacent to and north of the area and on the valley itself. Discharge is mainly by flow in the Duchesne River. Adjacent to and within the valley, ground water and surface water are intimately related, and they can interchange in several ways due to both natural and manmade conditions. The valley fill, which is composed mainly of outwash and related glacial debris, constitutes the mainground-water reservoir in the valley. The ground water in the fill is unconfined. The volume of ground water stored in the fill, and theoretically available by gravity drainage, is a minimum of 40,000 acre-feet; this volume fluctuates by a maximum of 10 percent annually. The discharge from wells and springs used for domestic, stock, public, and irrigation purposes in 1974 was about 2 cubic feet per second. Most ground water, except in parts of the Uinta Formation, and all the surface water sampled in the study area, was fresh. (Woodard-USGS)

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone
Hood, J. W.; Danielson, T. W.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Available from Utah Dept. of Natural Res. Div. of Water Rights

1636 West North Temple Room 220 Salt Lake City, Utah 84116. Utah Department of Natural Resources Technical Publication No 68, 1981. 143 p, 22 Fig, 4 Plates, 14 Tab, 48 Ref.,

Journal Announcement: SWRA1511

The Lower Dirty Devil River basin area in southeastern Utah has an area of about 4,300 square miles. Precipitation is the main source of water and averages 1.55 million acre-feet annually in the long term. Rocks in the area range from Precambrian to Holocene. The section of sedimentary rocks ranges from 7,300 to 23,000 feet in thickness. Major aquifers are the Mississippian age. They contain fresh to briny water. Their permeability is affected by folding, faulting, and igneous intrusion. The annual water supply averages 1.6 million acre-feet, of which an estimated 96% is consumed by evapotranspiration. The estimated long-term annual gross ground-water recharge is 34,000 acre-feet, of which 5,000 acre-feet recharges the Navajo Sandstone. Recoverable fresh to moderately saline water stored in the Navajo, Wingate, and Coconino Sandstones is estimated to be 210 million acre-feet, of which 89 million acre-feet is stored in the Navajo alone. Long-term withdrawals from the Navajo Sandstone, of up to 12,000 gallons per minute, probably would diminish the flow of the Dirty Devil River, but would have a negligible effect on the volume of ground water in storage or the flow of the Colorado River. (USGS)

Water Resources of the Northern Uinta Basin Area, Utah and Colorado, with Special Emphasis on Ground-Water Supply. (Duplicated see Colorado).

Hood, J. W.; Fields, F. K.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Utah Department of Natural Resources Technical Publication No. 62, 1978. 75 p, 20 fig, 5 plates, 9 tab, 44 ref.,

Journal Announcement: SWRA1217

Selected Hydrologic Data, Uinta Basin Area, Utah and Colorado. (Duplicated see Colorado).

Hood, J. W.; Mundorff, J. C.; Price, D.

Geological Survey, Salt Lake City, Utah. Water Resources Div.

Utah Basic-Data Release No 26, Salt Lake City, 1976. 321 p, 9 fig, 2 plates, 15 tab, 19 ref.,

Journal Announcement: SWRA1017

QUALITY OF GROUND WATER IN THE LOWER COLORADO RIVER REGION, ARIZONA, NEVADA, NEW MEXICO, AND UTAH

KISTER, L. R.

GEOLOGICAL SURVEY, WASHINGTON, D. C.

FOR SALE BY USGS, WASHINGTON, D. C. 20242, PRICE $1.00 PER SET. HYDROLOGIC INVESTIGATIONS ATLAS HA-478, 2 SHEETS, 1973. 3 FIG, 2 MAP, 17 REF.,

Journal Announcement: SWRA0713

DATA ARE PRESENTED ON THE AREAL AND VERTICAL

DISTRIBUTION OF THE DISSOLVED-SOLIDS AND FLUORIDE CONCENTRATIONS IN GROUNDWATER FOR THE LOWER COLORADO RIVER REGION, AN AREA OF ABOUT 140,000 SQUARE MILES IN PARTS OF ARIZONA, NEVADA, NEW MEXICO, AND UTAH. THE BASIN AND RANGE PROVINCE IS CHARACTERIZED BY ISOLATED NORTH TO NORTHWEST-TRENDING MOUNTAIN RANGES SEPARATED BY BROAD ALLUVIAL-FLOORED BASINS. THE WATER IN THE MOUNTAINS GENERALLY CONTAINS LESS THAN 1,000 MILLIGRAMS PER LITER DISSOLVED SOLIDS, EXCEPT WHERE WATER ISSUES FROM SALINE SPRINGS. THE DISSOLVED-SOLIDS CONCENTRATIONS IN THE GROUNDWATER IN THE ALLUVIUM RANGE FROM LESS THAN 100 THE PLATEAU UPLANDS PROVINCE INCLUDES A VARIETY OF LANDFORMS--CANYONS, BUTTES, MESAS, AND MOUNTAINS. ALTHOUGH IGNEOUS AND METAMORPHIC ROCKS ARE THE MAIN ROCK TYPES IN THE UPLANDS, THE SEDIMENTARY ROCKS FORM THE MOST IMPORTANT AQUIFERS. THE DISSOLVED-SOLIDS CONCENTRATIONS IN GROUNDWATER VARY ABOUT 1,500 SAMPLES ANALYZED. THE PRINCIPAL CONSTITUENTS IN THE GROUNDWATER IN THE UPLANDS ARE BICARBONATE, SULFATE, CALCIUM, SODIUM, AND CHLORIDE. THE CENTRAL HIGHLANDS PROVINCE FORMS A TOPOGRAPHIC HIGH THAT SEPARATES THE PLATEAU UPLANDS FROM THE BASIN AND RANGE LOWLANDS IN MOST OF THE LOWER COLORADO RIVER REGION. VOLCANIC ROCKS CROP OUT IN MUCH OF THE AREA, ARE PERMEABLE, AND WATER MOVES READILY THROUGH THEM AND RECHARGES THE UNDERLYING GROUNDWATER RESERVOIR. THIN ALLUVIAL DEPOSITS IN A FEW SMALL VALLEYS ALSO STORE GROUNDWATER. SPRINGS ALONG THE MOGOLLON RIM AND ELSEWHERE IN THE CENTRAL HIGHLANDS ARE THE SOURCE OF THE PERENNIAL FLOW IN THE GILA, SALT, AND VERDE RIVERS. THE GROUNDWATER GENERALLY CONTAINS LESS SALINE WATER TO STREAMS. (KNAPP-USGS)

BIBLIOGRAPHY OF U.S. GEOLOGICAL SURVEY WATER-RESOURCES REPORTS FOR UTAH
LAPRAY, B. A.
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
UTAH DEPARTMENT OF NATURAL RESOURCES, SALT LAKE CITY, INFORMATION BULLETIN NO 23, 1975. 58 P, 4 TAB.,
Journal Announcement: SWRA0819

THIS BIBLIOGRAPHY CONTAINS A COMPLETE LISTING TO DECEMBER 31, 1974, OF REPORTS RELATING TO THE WATER RESOURCES OF UTAH PREPARED BY PERSONNEL OF THE U.S. GEOLOGICAL SURVEY. DISCUSSIONS OF THE RELATED SUBJECTS OF GEOLOGY, HYDROLOGY, AND CHEMICAL QUALITY OF THE WATER ARE INCLUDED IN MANY OF THE REPORTS. THE REPORTS WERE, FOR THE MOST PART, PREPARED BY PERSONNEL ASSIGNED TO THE WATER RESOURCES DIVISION, UTAH DISTRICT, IN COOPERATION WITH STATE AND LOCAL AGENCIES. THE BIBLIOGRAPHY IS DIVIDED INTO FOUR MAJOR PARTS: (1) PUBLICATIONS OF THE GEOLOGICAL SURVEY; (2) PUBLICATIONS BY AGENCIES OF THE STATE OF UTAH; (3) OTHER PUBLICATIONS--REPORTS PREPARED BY SURVEY PERSONNEL, BUT PUBLISHED BY OTHER AGENCIES OR BY PROFESSIONAL ORGANIZATIONS IN THEIR JOURNALS; AND (4) OPEN-FILE REPORTS OF THE GEOLOGICAL SURVEY. (WOODARD-USGS)

Hydrologic studies of the U.S. Geological Survey in major coal-resources areas of Utah through 1980

Lines, G. C., 1981

U.S. Geological Survey Open-File Report 81-216, 20 p.

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979

Lines, G. C.; Plantz, G. G.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Geological Survey Open-File Report 81-138 (WRI), 1981, 56 p, 30 Fig, 1 Plate, 13 Tab, 17 Ref.,

Journal Announcement: SWRA1511

Surface-water quantity and quality were monitored at 12 gaging stations down-stream from mine and lease areas in the Wasatch Plateau, Book Cliffs, and Emery coal fields in central Utah. Measurements of base flow were made at 52 other sites in the region. The report describes the hydrologic setting of this important coal region and summarizes the surface-water data collected at the monitoring sites from August 1978 through September 1979. Coal mining and lease activities in each of the monitored basins also are described. Where possible, hydrologic impacts of coal mining are evaluated. Impacts include increases in streamflow and degradation of surface-water quality due to water discharged from underground mines. Other impacts include removal of water from ground-water storage, changes in the natural ground-water flow system and possibly the diminution of spring flows. Adequacy of the monitoring network to detect hydrologic changes due to mining is evaluated. In order to fully assess and quantify the impacts, comprehensive studies and monitoring of the ground-water system and water produced in mines are needed. (USGS)

Hydrology of the Ferron sandstone aquifer and effects of proposed surface-coal mining in Castle Valley, Utah, with a section on Stratigraphy by T. A. Ryer and a section on Leaching of overburden by R. H. Fuller

Lines, G. C. and Morrissey, D. J., 1980

To be released as a U.S. Geological Survey open-file report and duplicated as a U.S. Geological Survey Water-Supply Paper (in review).

Availability and chemical quality of water in the Ferron Sandstone Member of the Mancos Shale of Cretaceous age are evaluated. To aid in estimating drilling depths to reach and fully penetrate the aquifer, structure-contour and thickness maps for the Ferron are included. Records of wells and springs and chemical analyses of water from the Ferron are listed in tables.

The impacts of a proposed surface coal mine in the Emery area on the water resources are evaluated. Techniques used in the evaluation included a three-dimensional digital-computer model of the Ferron sandstone aquifer (Morrissey and others, 1980) and laboratory experiments that simulated leaching of overburden.

MAJOR THERMAL SPRINGS OF UTAH
MUNDORFF, J. C.
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
AVAILABLE FROM UTAH GEOLOGICAL AND MINERALOGICAL SURVEY, 103 UTAH GEOLOGICAL SURVEY BLDG., UNIV. OF UTAH, SALT LAKE CITY, 84112 - PRICE $3.00. UTAH GEOLOGICAL AND MINERALOGICAL SURVEY WATER-RESOURCES BULLETIN 13, 1970. 60 P, 23 FIG, 2 PLATE, 3 TAB, 74 REF.,
Journal Announcement: SWRA0422

AS PART OF A STUDY OF THE SPRINGS OF UTAH, RECONNAISSANCE DATA WERE OBTAINED ON THE THERMAL, CHEMICAL, AND GEOLOGIC CHARACTERISTICS OF THE MAJOR THERMAL SPRINGS OF UTAH. TEMPERATURES OF THE THERMAL SPRINGS STUDIED RANGED FROM 68 DEG TO 189 DEG F. NEARLY ALL THERMAL SPRINGS IN UTAH ARE IN OR NEAR FAULT ZONES. VERY FEW OF THESE SPRINGS ISSUE FROM VOLCANIC ROCKS, BUT SEVERAL SPRINGS ARE CLOSE TO AREAS OF LATE TERTIARY OR QUATERNARY VOLCANIC ROCKS. DISSOLVED-SOLIDS CONTENTS OF THE SPRINGS RANGE FROM AS LOW AS 214 PPM FOR A SPRING HAVING A TEMPERATURE OF 80 DEG F TO AS HIGH AS ABOUT 45,000 PPM FOR A SPRING HAVING A TEMPERATURE OF 132 DEG F. MOST SPRINGS ARE SODIUM CHLORIDE IN TYPE, AND ALL SPRINGS THAT CONTAIN MORE THAN 3,000 PPM OF DISSOLVED SOLIDS ARE OF THE SODIUM CHLORIDE TYPE. ONLY TWO SPRINGS IN THE STATE, ROOSEVELT AND ABRAHAM HOT SPRINGS, ARE IN POTENTIALLY VALUABLE GEOTHERMAL AREAS. SOME THERMAL SPRINGS HAVE LARGE DISCHARGES, LOW DISSOLVED-SOLIDS CONTENTS, AND FAIRLY LOW TEMPERATURES; THESE SPRINGS ARE VALUABLE AS WATER SUPPLIES FOR IRRIGATION AND STOCK USE. AN UNDESIRABLE EFFECT OF THE THERMAL SPRINGS IS THAT THEY ADD SIGNIFICANT AMOUNTS OF WATER HAVING HIGH DISSOLVED-SOLIDS CONTENTS TO SOME STREAMS AND LAKES. (KNAPP-USGS)

NONTHERMAL SPRINGS OF UTAH
MUNDORFF, J. C.
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
AVAILABLE FROM UTAH GEOL AND MINERALOG SURVEY, 103 UTAH GEOL SURVEY BLDG, SLC 84112, $4.00. UTAH GEOLOGICAL AND MINERALOGICAL SURVEY WATER-RESOURCES BULLETIN 16, AUGUST 1971. 70 P, 15 FIG, 2 PLATE, 2 TAB, 24 REF.,
Journal Announcement: SWRA0505

DATA ARE PRESENTED FOR ABOUT 4,500 NONTHERMAL SPRINGS THAT DISCHARGE IN THE STATE OF UTAH. MOST MAJOR SPRINGS HAVING DISCHARGE OF SEVERAL CUBIC FEET PER SECOND OR MORE ARE IN OR NEAR MOUNTAIN RANGES OR PLATEAUS WHERE PRECIPITATION IS MUCH GREATER THAN IN OTHER PARTS OF THE STATE. THE LARGEST INSTANTANEOUS DISCHARGE OBSERVED WAS 314 CFS AT MAMMOTH SPRING IN SOUTHWESTERN UTAH. DISCHARGES EXCEEDING 200 CFS WERE OBSERVED AT SWAN CREEK SPRING IN EXTREME NORTHERN UTAH, AND DISCHARGES OF 200 CFS WERE REPORTED FOR BIG BRUSH CREEK SPRING IN NORTHEASTERN UTAH. MAXIMUM DISCHARGES OF OTHER SPRINGS

RANGE FROM 25 TO 90 CFS. MAXIMUM DISCHARGES GENERALLY ARE DURING OR WITHIN A FEW WEEKS AFTER THE MAIN PERIOD OF SNOWMELT, WHICH IS USUALLY FROM LATE APRIL TO THE MIDDLE OF JUNE. THE LARGEST SPRINGS GENERALLY DISCHARGE FROM OR VERY NEAR CARBONATE ROCKS IN WHICH SOLUTION CHANNELS AND FRACTURES ARE NUMEROUS OR FROM AREAS OF POROUS OR FRACTURED VOLCANIC ROCKS. MOST NONTHERMAL SPRINGS IN UTAH PROBABLY ARE VARIABLE SPRINGS--THAT IS, THEIR VARIABILITY OF DISCHARGE EXCEEDS 100 PERCENT. MOST OF THE MAJOR SPRINGS DISCHARGE WATER THAT CONTAINS LESS THAN 500 PPM OF DISSOLVED SOLIDS, AND MOST OF THE WATER IS OF THE CALCIUM BICARBONATE TYPE. WATER FROM SPRINGS IS USED FOR DOMESTIC, MUNICIPAL, IRRIGATION, LIVESTOCK, MINING, AND INDUSTRIAL PURPOSES. (WOODARD-USGS)

Reconnaissance of Chemical Quality of Surface Water and Fluvial Sediment in the Dirty Devil River Basin, Utah
Mundorff, J. C.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Utah Department of Natural Resources Technical Publication No 65, 1979. 132 p, 4 Fig, 3 Plates, 7 Tab, 21 Ref.,
Journal Announcement: SWRA1404

This water-quality reconnaissance in the Dirty Devil River basin, Utah, covers an area of about 4,300 square miles. Data were obtained by the U.S. Geological Survey one or more times at 104 sites during the period from July 1975 to September 1976. The most pronounced change in chemical characteristics of water in streams in the Dirty Devil River basin occurs in a 15-mile reach of Muddy Creek between the major diversions 5 miles north of Emery and the point at which Highway I-70 crosses Muddy Creek. Dissolved-solids concentrations at the diversions are generally less than 300 milligrams per liter and at the lower end of the reach are commonly greater than 2,000 milligrams per liter. The Dirty Devil River, which is formed by the confluence of Muddy Creek and the Fremont River, has no perennial tributaries. Except during short periods of the thunderstorm runoff in tributaries, the flow is simply a composite of flow from Muddy Creek and the Fremont River. A few data on total coliform, fecal coliform, and fecal streptococci bacteria suggest a general absence of major biological pollution in the basin. Sediment discharge from the upper 1,000 square miles of the Fremont River basin and from the upper 400 square miles of Muddy Creek Basin is a very small part of sediment discharge of the Dirty Devil River. Less than half of the remaining 2,900 square miles of drainage area of the Dirty Devil River probably contributes most of the sediment that is discharged by the streams during a very small part of the time each year. (USGS)

RECONNAISSANCE OF CHEMICAL QUALITY OF SURFACE WATER AND FLUVIAL SEDIMENT IN THE PRICE RIVER BASIN, UTAH
MUNDORFF, J. C.
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.

UTAH DEPARTMENT OF NATURAL RESOURCES, SALT LAKE CITY, TECHNICAL PUBLICATION NO 39, 1972. 55 P, 13 FIG, 3 PLATE, 5 TAB, 22 REF.,

Journal Announcement: SWRA0617

THE PRICE RIVER BASIN IS MAINLY IN CARBON AND EMERY COUNTIES IN EAST-CENTRAL UTAH, AND THE TOTAL DRAINAGE AREA IS ABOUT 1,900 SQUARE MILES. NORMAL ANNUAL PRECIPITATION (1931-60) IS MORE THAN 30 INCHES IN HEADWATERS AREAS AND IS LESS THAN 8 INCHES IN THE DOWNSTREAM PART OF THE BASIN. SURFACE ROCKS IN THE BASIN RANGE IN AGE FROM JURASSIC TO QUATERNARY, BUT THE ROCKS HAVING PREDOMINANT INFLUENCE ON WATER QUALITY ARE MARINE SHALES OF CREATACEOUS AGE. THE GENERAL CHEMICAL CHARACTERISTICS OF THE MAIN STEM OF THE PRICE RIVER AS DETERMINED BY A RECONNAISSANCE DURING 1969-70 CHANGED MARKEDLY BETWEEN THE HEADWATERS AND THE MOUTH. THE DISSOLVED SOLIDS CONTENT ON THE PRICE RIVER. A ROUGH ESTIMATE OF THE SUSPENDED-SEDIMENT DISCHARGE OF PRICE RIVER AT WOODSIDE WAS AT LEAST 1,400,000 TONS DURING THE 1970 WATER YEAR. (WOODARD-USGS)

Reconnaissance of Water Quality in the Duchesne River Basin and Some Adjacent Drainage Areas, Utah

Mundorff, J. C.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Utah Department of Natural Resources, Salt Lake City, Technical Publication No 55, 1977. 47 p, 9 fig, 5 plates, 2 tab, 17 ref.,

Journal Announcement: SWRA1102

A water-quality reconnaissance in the Duchesne River basin and some adjacent drainage areas covered an area of about 4,400 square miles. Data were obtained one or more times at 108 sites during March 1973 to September 1974 and at 49 other sites during earlier years. Dissolved-solids concentrations are low in the surface water in the northern and western parts of the basin and increase markedly in the southeastern part of the basin. The increase results predominantly from diversion of large amounts of water having low dissolved-solids concentrations from upstream parts of the basin and the return to or entry into the stream of smaller amounts of water having much higher dissolved-solids concentrations. Additional diversions of water from the upper part of the basin will cause an increase in weighted average dissolved-solids concentrations in downstream reaches of the river. Tributaries to the Duchesne and Strawberry Rivers in the southern part of the basin have high boron concentrations. Concentrations as high as 20,000 micrograms per liter were observed at the mouth of Indian Canyon. Suspended-sediment concentrations as high as 36,200 milligrams per liter were observed in runoff from a thunderstorm in the southeastern part of the area. Sediment concentrations greater than 100,000 milligrams per liter could be expected during periods of intense thunderstorm runoff in many of the southern tributaries. (Woodard-USGS)

Reconnaissance of the quality of surface water in the San Rafael River basin, Utah

Mundorff, J. C. and Thompson, K. R., 1980

U.S. Geological Survey Open-File Report 80-574, 54 p. (to be duplicated as a Utah Department of Natural Resources Technical Publication).

Water in mountain streams in the study area during 1977-78 nearly always contained less than 500 mg/L of dissolved solids. The chemical quality of surface water deteriorated downstream from the mountains where the streams crossed a belt of land 10 to 15 miles wide where the gypsum- bearing Mancos Shale crops out. This same area contained nearly all the intensive irrigation in the San Rafael River basin. Numerous chemical analyses of surface water from sites throughout the basin are listed in tables.

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado

Naten, R. W.; Fuller, R. H.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Geological Survey Open-File Report 81-644 (WRI), 1981. 38 p, 26 Fig, 4 Tab, 12 Ref.,

Journal Announcement: SWRA1512

Biological sampling was carried out during 1976-78 in five streams in the southeastern Uinta Basin, Utah and Colorado, in order to provide baseline water-quality data for an area of potential oil-shale development. The biological activity in the streams sampled generally is limited by physical factors more so than by chemical constituents and plant nutrients. Characteristics of streamflow, such as high turbidity, fluctuating water levels, and moderate to high salinity, limit production of flora and fauna biomass. Samples were collected for the determination of bacterial and periphyton concentrations and benthic-invertebrate communities. Bacterial concentrations were generally small, with some fecal contamination, primarily from livestock and wildlife. Members of the order Chlorophyta (green algae) were the major periphytic algae present in three of the streams sampled. Bitter Creek was dominated by members of the order Cyanophyta (blue-green algae), and pennate diatoms were the predominant algae in Willow Creek. The benthic-invertebrate communities generally reflect a nonpolluted environment. Shannon-Weiner diversity indices ranged from 1.14 to 3.08. (USGS)

Developing a State Water Plan, Ground-Water Conditions in Utah, Spring of 1979

Price, D.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Utah Division of Water Resources Cooperative Investigations Report No. 18, 1979. 68 p, 37 fig, 3 tab, 3 ref.,

Journal Announcement: SWRA1301

The estimated total withdrawal of water from wells in Utah in 1978 was about 829,000 acre-feet, which was about 118,000 acre-feet less than in 1977 and 62,000 acre-feet greater than the average annual withdrawal for the period 1968-77. The decrease from 1977 was due primarily to decreases in withdrawals for irrigation. Precipitation in 1978 was above average in most of Utah. This made more surface water available, reducing dependence on ground water for irrigation. Relatively small ground-water declines were recorded in some of the more heavily developed areas. The above-average precipitation combined with increased runoff and reduced ground-water withdrawals, however, resulted in significant rises of ground-water levels in many parts of the State. (Woodard-USGS)

Map Showing General Availability of Ground Water in the Kaiparowits Coal-Basin Area, Utah
Price, D.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Available from Branch of Distribution, USGS Box 25286, Fed. Ctr. Denver CO 80225 price $1.50. Geological Survey Miscellaneous Investigations Series Map I-1033-B, 1977. 1 sheet.,
Journal Announcement: SWRA1216

This is one of a series of maps that describe the geology and related natural resources of the Kaiparowits coal-basin area, Utah. The map is based partly on records of water wells, springs, and coal and petroleum-exploration holes, partly on unpublished reports of field evaluations of prospective stock-water well sites by personnel of the U.S. Geological Survey, and partly on a 6-day field reconnaissance by the writer. Rocks ranging in age from Permian to Holocene are exposed in the Kaiparowits coal-basin area. They consist chiefly of sedimentary rocks--mostly interbedded sandstone, siltstone, shale, conglomerate, and limestone strata--in aggregate a thickness of several thousand feet. The minimum expected yields of individual wells shown on the map assume that the wells are at least 6 inches in diameter; fully penetrate the aquifer; either have no casing, perforated casing, or well screens opposite the aquifer; and are equipped with optimal pumping equipment. The yields shown are those that could be sustained indefinitely by pumping. The ranges of expected depth to ground water shown on the map are based on measured and reported depths of water in wells. Yields of most springs range from less than 1 to about 20 gallons per minute, but several springs discharge more than 100 gallons per minute. Much of the ground water (including springflow) may be too saline to drink. (Woodard-USGS)

Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah
Price, D.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Available from Br. of Dist. USGS, Box 25286, Fed. Ctr. Denver,

CO 80225. Price $2.50. Geological Survey Miscellaneous Investigations Series Map-I 1374, 1981. 1 Sheet, 23 Ref.,

Journal Announcement: SWRA1509

This is one of a series of maps that describe the geology and related natural resources of the Richfield Quadrangle, Utah. It shows known and inferred ranges of dissolved-solids concentrations in the ground water. Concentrations generaly range from 100 to 1,000 milligrams per liter throughout most of the map area. They are less than 100 milligrams per liter locally in some higher mountain areas and more than 10,000 milligrams per liter locally beneath the Sevier Desert and Sevier Lake bed. Several mineralized thermal springs discharge in the map area. They include Thermo, Roosevelt, Joseph, Red Hill, Monroe, Meadow, and Hatton Hot Springs. Dissolved-solids concentrations of those springs range from about 1,500 to about 8,000 milligrams per liter. (USGS)

MAP SHOWING GENERAL CHEMICAL QUALITY OF GROUNDWATER IN THE SALINAQUADRANGLE, UTAH

PRICE, D.

GEOLOGICAL SURVEY, WASHINGTON, D.C.

AVAILABLE FOR SALE BY USGS, WASHINGTON, D.C. 20242, PRICE - 75 CENTS. GEOLOGICAL SURVEY MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAPS, MAP I-591-K, 1972. 1 SHEET, 1 MAP.,

Journal Announcement: SWRA0613

THIS MAP OF SALINA QUADRANGLE, UTAH, SCALE 1:250,000, SHOWS THE GENERAL CHEMICAL QUALITY OF WATER AS DETERMINED FROM QUALITY-OF-WATER DATA COLLECTED BY THE U.S. GEOLOGICAL SURVEY AND COOPERATING STATE, LOCAL, AND FEDERAL AGENCIES. SOURCES OF DATA INCLUDE SPRINGS, AND WELLS THAT TAP AQUIFERS AT DEPTHS OF LESS THAN 1,000 FEET. VARIOUS COLORS ARE USED TO (WOODARD-USGS)

Map Showing General Quality of Ground Water in the Kaiparowits Coal-Basin Area, Utah

Price, D.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Available from Branch of Distribution, USGS Box 25286, Fed. Ctr. Denver CO 80225 price $1.50. Geological Survey Miscellaneous Investigations Series Map I-1033-A, 1977. 1 sheet.,

Journal Announcement: SWRA1216

This is one of a series of maps that describe the geology and related natural resources in the Kaiparowits coal-basin area. Chemical analyses of water from about 40 widely scattered springs, 20 coal-exploration holes on the Kaiparowits Plateau, and 7 water wells in the vicinity of the communities of Escalante and Glen Canyon were used to compile this map. All data were also available from a number of petroleum wells and exploration holes more than 5,000 feet deep. Ground water in most parts of the Kaiparowits coal-basin area ranges from fresh to slightly saline. In general, the fresh waters are of the calcium bicarbonate type, and the saline water are of the sodium sulfate type. The available chemical analyses indicate that the ground water is generally freshest throughout the headwater areas of the Escalante River, along Cottonwood and Hackberry Canyons, and in the immediate vicinity of Lake Powell. In these areas, the The ground water is generally most highly saline along the southern margin of the Kaiparowits Plateau and in the northeast corner of the study area. (Woodard-USGS)

Map Showing Principal Drainage Basins, Principal Runoff-Producing Areas, and Selected Streamflow Data in the Kaiparowits Coal-Basin Area, Utah

Price, D.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Available from Branch of Distribution, USGS, Box 25286, Fed. Ctr. Denver CO 80225, price $1.25. Geological Survey Miscellaneous Investigation Series Map I-1022-E, 1978. 1 Sheet, 3 Ref.,

Journal Announcement: SWRA1304

This is one of several maps in the U.S. Geological Survey Miscellaneous Investigations Map Series that describe the geology and related natural resources of the Kaiparowits coal-basin area, Utah. About 96 percent of the area drains to the Colorado River, mostly through the Escalante River and Wahweap, Warm, and Last Chance Creeks. The remaining 4 percent drains to the Great Basin through the Sievier River. The Escalante River and several of its headwater tributaries are perennial streams, but most others in the area are intermittent of ephemeral. Estimated average annual runoff in the area ranges from less than 1 inch in most places to more than 10 inches in the headwater area of the Escalante River. Most of the runoff, which occurs during late spring and early summer, results from melting snow and seasonal rains. Summer cloudburst flooding is common throughout the area. Peak flood flows of more than 3,000 cubic feet per secnod have been recorded from drainage areas of less than 100 square miles, and a peak floodflow of more than 15,000 cubic feet per second has been recorded on the Paria River. (Woodard-USGS)

Map showing selected surface-water data for the Alton-Kolob coal-fields area

Price, Don, 1982

U.S. Geological Survey Miscellaneous Investigations Map I-1235-D

Map showing selected surface-water data for the Manti 30 x 60-minute quadrangle, Utah

Price, Don, 1982

U.S. Geological Survey Miscellaneous Investigations Map I-1482

Map showing selected surface-water data for the Nephi 30 x 60-minute quadrangle,

Price, Don, 1982
U.S. Geological Survey Miscellaneous Investigations Map I-1512

Map showing selected surface-water date for the Price 30 X 60-minute quadrangle, Utah
Price, Don, 1982
U.S. Geological Survey Miscellaneous Investigations I-1513

Map showing selected surface-water data for the Huntington 30 X 60-minute quadrangle, Utah
Price, Don, 1982
U.S. Geological Survey Miscellaneous Investigations Map I-1514

SELECTED HYDROLOGIC DATA IN THE UPPER COLORADO RIVER BASIN
PRICE, D.; WADDELL, K. M.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
HYDROLOGIC INVESTIGATIONS ATLAS HA-477, 1973. 2 SHEETS, 3 TAB, 4 GRAPHS, 9 MAPS, 57 REF.,
Journal Announcement: SWRA0722
THE GROUNDWATER RESOURCES OF THE UPPER COLORADO RIVER BASIN ARE DESCRIBED IN A 2-SHEET HYDROLOGICAL ATLAS. THE MAPS IN THIS ATLAS ARE HIGHLY GENERALIZED, AND ARE INTENDED TO PROVIDE ONLY A GENERAL UNDERSTANDING OF THE GEOLOGY, GROUNDWATER CONDITIONS, AND CHEMICAL QUALITY OF WATER IN THE BASIN AS A WHOLE. ROCKS RANGING IN AGE FROM PRECAMBRIAN TO HOLOCENE ARE EXPOSED IN THE UPPER COLORADO RIVER BASIN. THE ROCKS HAVE BEEN GROUPED INTO FIVE BASIC GEOHYDROLOGIC UNITS ON THE BASIS OF AGE AND GENERAL LITHOLOGIC CHARACTERS. ALLUVIUM IN GEOHYDROLOGIC UNIT 1 AND VOLCANIC ROCKS IN GEOHYDROLOGIC UNIT 2 CONTAIN AQUIFERS THAT HAVE THE HIGHEST HYDRAULIC CONDUCTIVITIES. YIELDS TO INDIVIDUAL WELLS AND SPRINGS GENERALLY ARE SMALL IN MOST PARTS OF THE BASIN. PROPERLY LOCATED AND CONSTRUCTED WELLS IN THE THICKER (100 FT OR MORE) ALLUVIAL DEPOSITS YIELD 500 TO MORE THAN 1,000 GPM, AND SOME OF THE MOST PRODUCTIVE WELLS IN THE ENTIRE BASIN TAP BOTH ALLUVIUM AND VOLCANIC ROCKS IN THE UPPER FREMONT RIVER VALLEY, WHERE SEVERAL WELLS YIELD MORE THAN 1,000 GPM. ONLY ABOUT 5 PERCENT OF THE MAXIMUM ESTIMATED VOLUME OF GROUNDWATER STORED IN THE BASIN IS IN UNCONSOLIDATED DEPOSITS THAT HAVE HIGH HYDRAULIC CONDUCTIVITIES. ABOUT 85 PERCENT OF THE MAXIMUM ESTIMATED VOLUME OF STORED WATER OCCURS IN THE ROCKS OF GEOHYDROLOGIC UNITS 3, 4, AND 5, WHICH GENERALLY YIELD THE WATER SLOWLY; AND MUCH OF THAT WATER IS MODERATELY TO HIGHLY MINERALIZED. HYDROGRAPHS OF WELLS INDICATE THAT THERE HAVE BEEN NO SIGNIFICANT DEPLETIONS OF STORAGE IN THE BASIN OWING TO GROUNDWATER DEVELOPMENT. (KNAPP-USGS)

HYDROLOGIC RECONNAISSANCE OF THE SOUTHERN UINTA BASIN, UTAH AND COLORADO
PRINCE, D.; MILLER, L. L.

GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.

UTAH DEPARTMENT OF NATURAL RESOURCES, SALT LAKE CITY, TECHNICAL PUBLICATION NO 49, 1975. 66 P, 11 FIG, 3 PLATE, 15 TAB, 38 REF.,

Journal Announcement: SWRA0821

THE SOUTHERN UINTA BASIN COVERS ABOUT 4,900 SQUARE MILES IN NORTHEASTERN UTAH AND NORTHWESTERN COLORADO. FOR THE MOST PART, IT IS AN ARID TO SEMIARID REGION. DURING THE PERIOD 1941-70, AVERAGE ANNUAL PRECIPITATION RANGED FROM LESS THAN 8 INCHES IN THE NORTH-CENTRAL PART TO MORE THAN 26 INCHES IN THE EXTREME WESTERN PART. THE AREA AVERAGES ABOUT ONE PERSON FOR EVERY 4.5 SQUARE MILES. IT IS UTILIZED MAINLY FOR LIVESTOCK GRAZING AND THE PRODUCTION OF OIL AND GAS. NET IMPORTS OF WATER FROM THE DUCHESNE RIVER FOR IRRIGATION WITHIN THE SOUTHERN UINTA BASIN AVERAGE ABOUT 70,000 ACRE-FEET PER YEAR AS OF 1972. ABOUT 94% OF THE AVERAGE ANNUAL WATER SUPPLY FROM PRECIPITATION AND IMPORTS IS CONSUMED WITHIN THE SOUTHERN UINTA BASIN BY EVAPOTRANSPIRATION AND SUBLIMATION FROM THE WINTER SNOWPACK. BOTH THE SURFACE WATER AND GROUNDWATER ARE SALINE THROUGHOUT A MAJOR PART OF THE BASIN. ONLY IN THE HEADWATER AREAS ALONG THE SOUTH RIM OF THAT SUBBASIN CAN FRESH WATER GENERALLY BE FOUND. THE MOST PROMISING OPPORTUNITIES FOR OBTAINING LARGE SUSTAINED WATER SUPPLIES ARE SURFACE RESERVOIR STORAGE OF RUNOFF IN THE HEADWATERS OF THE LARGER STREAMS. (WOODARD-USGS)

Hydrologic Evaluation of the Alton Reclamation-Study Site, Alton Coal Field, Utah

Sandberg, G. W.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Geological Survey open-file report 79-346, 1979. 53 p, 5 fig, 8 tab, 7 ref.,

Journal Announcement: SWRA1224

An investigation was conducted from July 1974 to September 1977 to define general hydrologic conditions at a reclamation-study site in the Alton coal field near Kanab, Utah. The average annual streamflow through the area was less than 600 acre-feet, and the water carried little sediment except during floods which result from intense local storms. Most of the surface water seeps into the ground or is diverted for irrigation downstream from the study area. Ground-water data were insufficient to define the potentiometric surface in most of the area. The water level in each of the three observation wells is above the coal layer in the immediate area of the well. A larger network of wells is needed to define the potentiometric surface throughout the area and to show its relation to surface water and the location of the coal layers. Hydrologic data should be collected continuously to establish a hydrologic base before mining begins, and data collection should be continued through the periods of mining and reclamation. (Woodard-USGS)

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1972
SUMSION, C. T.
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
UTAH DIVISION OF WATER RESOURCES COOPERATIVE INVESTIGATIONS REPORT NO 10, 1972. 73 P., 37 FIG, 2 TAB, 8 REF.,
Journal Announcement: SWRA0523

THE ESTIMATED WITHDRAWAL OF WATER FROM WELLS IN UTAH IN 1971 WAS 710,000 ACRE-FEET, OR ABOUT 30,000 ACRE-FEET MORE THAN FOR 1970. IN 1971, PRECIPITATION IN THE NORTH-CENTRAL DIVISION WAS 3.85 INCHES ABOVE NORMAL AND 0.29 INCH ABOVE NORMAL IN THE SOUTH-CENTRAL DIVISION; THESE TWO DIVISIONS INCLUDE MOST OF THE MAJOR AREAS OF GROUNDWATER DEVELOPMENT IN THE STATE. THE SOUTHEAST DIVISION SUFFERED A DEFICIENCY OF 0.30 INCH DURING 1971. FROM FEBRUARY-MARCH 1971 TO FEBRUARY-MARCH 1972, GROUNDWATER LEVELS GENERALLY DECLINED IN SOUTHWESTERN UTAH BECAUSE MORE GROUNDWATER WAS WITHDRAWN FOR IRRIGATION, AND ROSE IN NORTHERN UTAH WHERE MORE SURFACE WATER WAS AVAILABLE FOR IRRIGATION. CONDITIONS IN THE CENTRAL PART OF THE STATE WERE VARIABLE, AND NO CONSISTENT PATTERN OF WATER-LEVEL CHANGE IS EVIDENT. GROUNDWATER DEVELOPMENT AND CHANGES IN GROUNDWATER CONDITIONS IN THE MAJOR AREAS OF GROUNDWATER DEVELOPMENT ARE SUMMARIZED. (WOODARD-USGS)

Selected Coal-Related Ground-Water Data, Wasatch Plateau-Book Cliffs Area, Utah
Sumsion, C. T.
Geological Survey, Salt Lake City, UT. Water Resources Div.
Geological Survey open-file report 79-915, 1979. 25 p, 1 Fig, 1 Plate, 7 Tab, 9 Ref.,
Journal Announcement: SWRA1317

The Wasatch Plateau-Book Cliffs area in east-central Utah consists of about 8,000 square miles within the upper Colorado River drainage system. Coal production in the area is expected to increase from 8 million tons to as much as 30 million tons annually within the next 10 years. Most sources of water supply will be subjected to possible contamination and increased demands by coal-related municipal and industrial growth in the area. The report presents a compilation of coal-related ground-water data from many unpublished sources for the use of local and regional water planners and users. The report includes generalized stratigraphic sections and hydrologic characteristics of rocks in the Wasatch Plateau-Book Cliffs area, records of selected test holes and water wells, logs of selected test holes and water wells, water levels in selected wells, records of selected springs, records of ground-water discharge from selected mines, and chemical analyses of water from selected test holes, water wells, springs, and mines. (Kosco-USGS)

GROUNDWATER CONDITIONS IN UTAH, SPRING OF 1970
SUMSION, C. T.; BJORKLUND, L. J.; BOLKE, E. L.; MOWER, R. W.; HERBERT, L. R.
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
UTAH DIVISION WATER RESOURCES COOPERATIVE INVESTIGATIONS REPORT NO 8, 1970. 71 P, 36 FIG, 2 TAB, 7 REF.,
Journal Announcement: SWRA0401

THIS REPORT CONTAINS INFORMATION ON WELL CONSTRUCTION, GROUNDWATER WITHDRAWALS, WATER-LEVEL CHANGES, AND RELATED CHANGES IN PRECIPITATION AND STREAMFLOW IN UTAH. IT ALSO CONTAINS SUPPLEMENTARY DATA THAT ARE RELATED TO GROUNDWATER USE IN SOME AREAS. LESS THAN 2% OF THE WELLS IN UTAH OBTAIN WATER FROM CONSOLIDATED ROCKS. THE CONSOLIDATED ROCKS THAT YIELD THE MOST WATER ARE LAVA FLOWS, LIMESTONE, AND SANDSTONE. MORE THAN 98% OF THE WELLS IN UTAH DRAW WATER FROM UNCONSOLIDATED ROCKS. MOST WELLS THAT TAP PARTLY FILLED WITH DEBRIS FROM THE ADJACENT MOUNTAINS. THE ESTIMATED TOTAL WITHDRAWAL OF WATER FROM WELLS IN UTAH DURING 1969 WAS ABOUT 670,000 ACRE-FEET, ABOUT 40,000 ACRE-FEET MORE THAN THAT REPORTED FOR 1968. PRECIPITATION DURING MOST OF THE GROWING SEASON WAS LESS THAN NORMAL IN PARTS OF THE STATE WHERE THE LARGEST WITHDRAWALS ARE FOR IRRIGATION, SO IRRIGATION WITHDRAWALS INCREASED IN THESE AREAS. ALTHOUGH ALL TYPES OF GENERALLY ROSE THROUGHOUT THE STATE FROM MARCH 1969 TO MARCH 1970 AS A RESULT OF ABOVE-NORMAL PRECIPITATION. GROUNDWATER DEVELOPMENT AND CHANGES IN GROUNDWATER CONDITIONS IN THE MAJOR AREAS OF GROUNDWATER DEVELOPMENT ARE SUMMARIZED. (KNAPP-USGS)

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN SELECTED COAL-ENERGY AREAS OF UTAH
WADDELL, K. M.
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
OPEN-FILE REPORT, APRIL 1976. 21 P, 5 FIG, 2 TAB, 12 REF.,
Journal Announcement: SWRA0917

PLANNED COAL DEVELOPMENT IN UTAH IN THE NEXT DECADE INCLUDES THERMAL-ELECTRIC AND COAL GASIFICATION PLANTS AND SLURRY PIPELINES WITH ESTIMATED WATER REQUIREMENTS THAT MAY EXCEED 200,000 ACRE-FT (246.6 CUBIC HECTOMETRES) ANNUALLY. THE U.S. GEOLOGICAL SURVEY PRESENTLY MAINTAINS A MINIMAL MONITORING PROGRAM ON STREAMS AND WELLS IN THE COALFIELD AREAS. THE CHEMICAL-QUALITY DATA ARE OBTAINED AND 14 AT WHICH SEDIMENT DATA ARE OBTAINED. THE GROUNDWATER MONITORING PROGRAM CONSISTS OF 170 WELLS FOR WATER-LEVEL MONITORING AND 16 WELLS AT WHICH SAMPLES ARE OBTAINED FOR CHEMICAL ANALYSIS. FIVE AREAL WATER-RESOURCES STUDIES ARE BEING MADE IN THE VICINITY OF UTAH COALFIELDS. THE PRINCIPAL STUDY WHERE COAL MINING IS MOST ACTIVE IS IN THE WASATCH PLATEAU-BOOK CLIFFS AREA. THIS IS A 2-YEAR HYDROLOGIC RECONNAISSANCE DESIGNED TO PROVIDE AN ASSESSMENT OF THE CURRENT HYDROLOGY, WHICH WILL AID IN THE SOLUTION TO SOME OF THE POTENTIAL PROBLEMS THAT MAY OCCUR AS A RESULT OF COAL-ENERGY DEVELOPMENT. (WOODARD-USGS)

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah

Waddell, K. M.; Contratto, P. K.; Sumsion, C. T.; Butler, J.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Geological Survey Water-Supply Paper 2068, 1981. 45 p, 10 Fig, 9 Plates, 8 Tab, 19 Ref.,

Journal Announcement: SWRA1505

Data obtained during a hydrologic reconnaissance in 1975-77 in the Wasatch Plateau-Book Cliffs coal area of Utah were correlated with existing long-term data. Maps were prepared showing average precipitation, average streamflow, stream temperature, ground- and surface-water quality, sediment yield, and geology. Recommendations were made for suggested approaches for continued monitoring in the coal areas. During the 1931-75 water years, the minimum discharges for the five major streams that head in the area ranged from about 12,000 to 26,000 acre-feet per year, and the maximum discharges ranged from about 59,000 to 315,000 acre-feet per year. Correlations indicate that 3 years of low-flow records at stream sites in the Wasatch Plateau would allow the development of relationships with long-term sites that can be used to estimate future low-flow records within a standard error of about 20 percent. Most water-quality degradation in streams occurs along the flanks of the Wasatch Plateau and Book Cliffs. In the uplands, dissolved-solids concentrations generally ranged from less than 100 to in the Wasatch Plateau and Book Cliffs discharge from the Star Point Sandstone or younger formations, and the water generally contains less than from about 2.0 to 2000 gallons per minute. The Blackhawk Formation, which is the principal coalbearing formation, produces water in many of the mines. The dissolved-solids concentration in water discharging from springs

Selected hydrologic data, Price River Basin, Utah, Water Years 1979 and 1980

Waddell, K. M., Dodge, J. E., Darby, D. W., and Theobald, S. M., 1982

U.S. Geological Survey Open-File Report 82-916

Selected Hydrologic Data, 1931-77, Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah

Waddell, K. M.; Vickers, H. L.; Contratto, P. K.

Geological Survey, Salt Lake City, UT. Water Resources Div.

Open-file report 78-121, 1978. 33 p, 2 fig, 1 plate, 14 tab, 4 ref.,

Journal Announcement: SWRA1206

The Wasatch Plateau-Book Cliffs coal-fields area in east-central Utah includes a significant part of the State's coal resources and is currently (1977) the most active coalmining area in the State. Data gathered by the U.S. Geological Survey are presented as part of a hydrologic reconnaissance in cooperation with the U.S. Bureau of Land Management during the period July 1975-September 1977 as well as selected data for the period 1931-75. Also included are selected data collected by private, State, and other Federal agencies. Types of data include water-level records, logs of selected wells, discharge of springs, wells, and mines, gaged and estimated streamflow, chemical analyses of water from springs, wells, mines, and streams, and laboratory analyses of streambed material and formation samples. The report is intended to make data available to those assessing the water resources that may be affected by coal-mining activities in the Wasatch Plateau-Book Cliffs coal-field are. (Woodard-USGS)

BIBLIOGRAPHY OF U.S. GEOLOGICAL SURVEY WATER-RESOURCES REPORTS FOR UTAH

GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.

UTAH DEPARTMENT OF NATURAL RESOURCES INFORMATION BULLETIN NO 22, 1972. 53 P, 4 TAB.,

Journal Announcement: SWRAU512

THIS BIBLIOGRAPHY CONTAINS A COMPLETE LISTING TO DECEMBER 31, 1971, OF REPORTS RELATING TO THE WATER RESOURCES OF UTAH PREPARED BY PERSONNEL OF THE U.S. GEOLOGICAL SURVEY. RELATED SUBJECTS INCLUDE GEOLOGY, HYDROLOGY, AND CHEMICAL QUALITY OF THE WATER. THE REPORTS WERE, FOR THE MOST PART, PREPARED BY PERSONNEL ASSIGNED TO THE WATER RESOURCES DIVISION, UTAH DISTRICT, IN COOPERATION WITH STATE AND LOCAL AGENCIES. THE BIBLIOGRAPHY IS DIVIDED INTO FOUR MAJOR PARTS: (1) PUBLICATIONS OF THE GEOLOGICAL SURVEY; (2) PUBLICATIONS BY AGENCIES OF THE STATE OF UTAH; (3) OTHER PUBLICATIONS--REPORTS PREPARED BY SURVEY PERSONNEL, BUT PUBLISHED BY OTHER AGENCIES OR BY PROFESSIONAL ORGANIZATIONS IN THEIR JOURNALS; AND (4) OPEN-FILE REPORTS OF THE GEOLOGICAL SURVEY. (WOODARD-USGS)

Water Resources Data for Utah, Published annually since 1975

Geological Survey, Salt Lake City, UT. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161.

Water resources data for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoir; and water levels and water quality in wells and springs.

Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Utah. (Woodard-USGS)

Allen-Warner Valley Energy System, Southern Utah
BLM, Cedar City, Utah
FEIS, 1980

This Statement analyzes the impacts of surface mining 212 million tons of Dakota Formation coal, followed by underground mining 100 million tons over a period of 40 years. The coal would be slurried and pipelined 73 miles to the proposed Warner Valley power plant in Utah, and 183 miles to the proposed Harry Allen power plant in Nevada. The slurry would require about 8,300 acre-feet per year of water from the Navajo Sandstone, some 600 to 800 feet below the coal. The coal crops out on the eastern escarpment and southern tip of the southward sloping, elongate Paunsagunt Plateau. The rocks dip gently northward. The coal-bearing Dakota Formation is overlain by the 650- to 750-foot-thick, relatively impermeable Tropic Shale, and is separated from the Navajo Sandstone below by as much as 800 feet of relatively impervious rocks including the Carmel Formation. The area drains by through-flowing Kanab Creek and Johnson Canyon Wash and their steep ephemeral tributaries extending into the escarpments. Most of the base flow of Kanab Creek is diverted for irrigation above the site. Alluvial wells provide irrigation and stock water along Kanab Creek as it crosses the site, and along Johnson Canyon Wash downstream from the site. All drainages carry thunderstorm-induced heavy sediment loads. Small amounts of mineralized (up to several thousand milligrams per liter dissolved solids) water occurs perched in rocks above the Tropic Shale and issue as springs and seeps on valley sides. Alluvial valley floors undoubtedly exist in places along the major valleys but their existence must be verified. The Navajo Sandstone, as much as 2,000 feet thick, produces hundreds of gallons per minute of water containing less than 400 milligrams per liter dissolved solids to wells. Storage in the aquifer has been estimated to be from 19,000 to 200,000 acre-feet per square mile. Although contended by one investigator who believes significant Navajo recharge occurs vertically through the Tropic Shale, most recharge probably takes place at the outcrop. If so, effects of pumping for slurry would displace down dip, and would not extend to the outcrop area where the aquifer provides base flow to streams. Computer simulations of proposed Navajo pumping probably have produced the range of realistic results because of the variety of aquifer parameter values assumed by three independent investigators. Replacement water for the 20 springs removed by mining could be provided by the proponent. Owing to the existence of poor quality shallow ground water, disrupted aquifer water may not degrade receiving streams.

### Alton Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in the Alton Coal Field, southwestern Utah

BLM, Denver, Colorado
EMRIA Report No. 4-75

The Alton site, 3.6 square miles of the much larger Alton Coal Field, contains about 27 million tons of identified coal within 200 feet of land surface which could be surface mined. The main coal bed, 16 feet thick, is in the upper part of the Dakota (sandstone) Formation. It crops out near bottoms of steep-sided valleys, and in the north, is as much as 200 feet below the south-sloping mesa tops. The mesas are dissected by gullies draining ephemerally to the comparatively wide, flat valley of Skutumpah Creek and to the narrow, steep-sided valley of Thompson Creek. Both creeks are perennial, but flashy. The area is highly faulted, displacing both coal and aquifers. Little water occurs in the relatively impermeable Tropic Shale at the surface above the Dakota. In some places, small quantities are in the fractured coal beds, and in one place, in the Dakota more than 100 feet above the coal. Less than a mile away water is 130 feet below the coal. Dissolved solids in four test holes ranged from 641 to 2,210 milligrams per liter, sulfate being the chief constituent in the more highly mineralized waters. Mining will encounter less water than needed for operations. Special protection and restoration practices will be required to prevent further deterioration of water quality and to avoid increasing existing high erosion and sedimentation.

### Reclaimability Analysis of the Emery Coal Field, Emery County, Utah

BLM, Denver, Colorado
EMRIA Report No. 16-79

Most of the 3.5-square-mile Emery study site about 5 miles south of Emery in the Emery Coal Field occupies a gently north-westward sloping, slightly rolling, partially dissected mesa. Relief is about 1,000 (?) feet. The rugged east-facing escarpment in the northern part of the site drains into south-flowing Muddy Creek (lower part perennial). The southern part drains down the mesa to Quitchupah Creek. Annual precipitation is about 7.5 inches. An undetermined amount of strippable coal in the upper Ferron Sandstone Member of the Mancos shale formation underlies less than 100 feet of overburden in about 40 acres in the extreme south and ± 30 acres in the extreme north. Small amounts of water may occur intermittently in and above the coal. Larger amounts occur in deeper aquifers.

Emery Power Plant, Utah
BLM, Richfield, Utah
FES, 1976

This document evaluates the impacts of an 860-megawatt coal-fired electric generating plant in Castle Valley, 20 miles north-northeast of Emery, central Utah. The plant would use 84 million tons of coal in 35 years from the existing Wilberg underground mine in Grimes Wash 13 miles northwest. The generator site required draining shallow, poor quality (9,000 milligrams per liter dissolved solids) ground water at a rate of 80,000 gallons per day into Rock Canyon Creek. About 10 million tons of ash and sludge would cover 160 acres an average of 15 to 25 feet thick in an area of shallow water table. About 7,000 acre-feet per year of water would be consumed by purchase of decreed water rights from Millsite Reservoir on Ferron Creek 11 miles southwest of the plant. Coal is in the Hiawatha and Bear Canyon seams of the Upper Cretaceous Mesaverde Group Blackhawk Formation, which crop out about 1,000 feet below the top of a south-pointing finger of the Wasatch Plateau (East Mountain). The coal is overlain by the Price River, North Horn, and Flagstaff Formations. These sedimentary strata dip about 5 degrees to the west. Consumption of 7,000 acre-feet of water annually would reduce dissolved solids content of the Colorado River system by nearly 8,000 tons (0.5 to 0.6 milligrams per liter), and reduce flow at Lee's Ferry by 2,000 acre-feet (0.15 percent of total flow) per year. Subsidence following mining, if it occurs, could affect springs and reduce flow in Roan Canyon, Deer Creek and Grimes Wash, and would raise or lower water levels in Snow and Flag Lakes.

Emery Power Plant, Units 3 and 4, Utah
BLM, Richfield, Utah
FES, 1979

This document evaluates the impacts of adding 800 megawatt generating capacity to the Emery Power Plant in Castle Valley, 20 miles north-northeast of Emery, central Utah. The plant would require 70 million additional tons of coal over 35 years from the existing Wilberg and Church mines and 14,000 acre-feet of water annually. The water would come from existing or proposed reservoirs on Ferrin and Cottonwood Creeks, both tributary to the San Rafael, Green, and Colorado Rivers. Annual precipitation is 8.19 inches. About 10 million tons of ash and sludge would be deposited on 160 acres near the plant site. The coal is in the Hiawatha and Bear Canyon seams of the Upper Cretaceous Mesaverde Group Blackhawk Formation. They crop out about 1000 feet below the top of a south-pointing finger of the Wasatch Plateau (East Mountain). The coal is overlain by the Price River, North Horn and Flagstaff Formations. These sedimentary strata dip about 5 degrees to the west. Water consumption would eliminate 3,415 irrigated acres, reduce San Rafael River flow by 7,700 acre feet per year (10%), and reduce annual flow at Lee's Ferry, Colorado River, by 3,850 acre-feet (0.03%). Mine subsidence, if it occurs, could affect aquifers above the mines, and springs and surface waters.

Rehabilitation Potential for the Henry Mountain Coal Field, Southeastern Utah
BLM, Denver, Colorado
EMRIA Report No. 15-78

The 8-square-mile Henry Mountain Coal Field study site is an irregular 6- by 2-mile strip extending across Wildcat Mesa on the west and Sweetwater Creek, Pete Steele Bench, Dugout Creek, and Apple Brush Flat on the east. Relief is about 600 feet. Dry washes draining to creeks extend into the mesa and piedmont escarpments. Precipitation is 8 to 9 inches, evaporation 64.8 inches and evapotranspiration 21 to 27 inches annually. Several thin coal beds occur in the Emery Sandstone tongue of the Mancos Shale Formation. Maximum coal thickness, in one of eight core holes, is 5 feet. Very little water occurs in the coal and overburden. Water for revegetation might come from water harvesting, 5,000-foot well(s) in the Navajo Sandstone Formation (uncertain yield and quality) or purchase, or any combination.

Intermountain Power Project
BLM, Richfield, Utah
FEIS, 1979

The operation of the plant would consume 50,000 acre-feet of water annually. The use of water from the Fremont River would decrease the downstream flow by 57 percent and increase the salinity of the Colorado River, and could require the retirement of 7,200 to 7,800 acres of irrigated farmland. The natural flow of 24 springs and seeps and four wells could be stopped for over 50 years beyond the life of the project.

Kaiparowits Project, southern Utah
BLM, Cedar City, Utah
FEIS, 1976

This statement evaluates impacts of a proposed 3,000 megawatt coal-fired electric generating plant, four underground coal mines, a limestone quarry, all in central southern Utah, and transmission lines extending to southern

California. The plant is on a narrow, southern canyon-bound extension (Fourmile Bench) of the Kaiparowits Plateau. The mine entries are inclined into the John Henry Member of the Cretaceous Straight Cliffs Formation. The minable leased coal, in four principal beds, ranges from 100 feet beneath canyon floors to 900 feet below the bench surface. The proposed mine straddles the Smokey Mountain anticline. The underlying Dakota Sandstone dips several degrees northeast and southwest. The 47,768-acre lease includes more than 1.8 billion tons of coal in beds more than 4 feet thick. Twelve million tons will be mined and 9 million tons will be for use in the power plant. The plant and mine entrance areas are drained by ephemeral tributaries to Lake Powell (Colorado River). Annual precipitation is 10 inches at the plant site and 7 inches at the mine entrances, about 6 to 10 miles southeast and 500 feet lower than the plant site. The main ground water body begins about 1,000 feet below the plateau surface and 100 feet beneath the canyon bottoms. Small quantities of fresh to slightly saline water occur sporadically, perched in the coal and in lenticular sandstones above and below the coal, and issue as springs in the canyon sides. The power plant would consume 47,000 acre feet per year, and the mine 3,000 acre-feet per year of water, both from Lake Powell, comprising 3.8 percent of Utah's allotment. The "new town" would need 9,690 acre-feet per year from the underlying Upper Triassic (?) Navajo Sandstone, possibly tributary (bank storage) to Lake Powell. This consumption would increase salinity in Lake Powell by about 2 milligrams per liter. Mining could cause subsidence of 10 to 14 feet over 63 square miles and disrupt perched aquifers now yielding 160 acre-feet per year and comprising 0.53 percent of the impact area.

Uinta - Southwestern Utah Regional Coal
BLM, Salt Lake City, Utah
FEIS, Undated (1981?)

This statement analyzes impacts of leasing 275.7 million tons of recoverable coal in 8 tracts in the Wasatch Plateau and Emery Coal Fields on the Wasatch Plateau and in 4 tracts in the Kaiparowits Coal Field on the Kaiparowits Plateau. The Wasatch Plateau coal, 187.8 million tons, is in the lower third of the Cretaceous Blackhawk Formation, and in the Ferron Sandstone Member of the Mancos Shale Formation. All but 50 million tons would be mined underground. The Kaiparowits coal, 19.5 million tons in the John Henry Member of the Cretaceous Straight Cliffs Formation would be mined underground. Precipitation on the Wasatch Plateau ranges from 6 to 25 inches per year, and on the Kaiparowits from 8 to 12 inches per year. Only one tract has a through-flowing stream, the sometimes dry perennial Muddy Creek. Small amounts of water occur perched above and in the coal layers, ranging from fresh to slightly saline. The Ferron Sandstone provides as much as 50 gallons per minute to wells in parts of the Wasatch Plateau. The Navajo Sandstone can sustain as much as 1,000 gallons per minute to wells beneath the Kaiparowits Plateau away from its outcrop area. Mining would have no effect on the regional groundwater system; impacts would be limited to mine areas. Surface-mined areas would have higher recharge and storage. Underground mining would diminish or alter points of spring discharge. Total mine drainage of less than 500 acre-feet per year would not seriously affect water quality.

Uinta-Southwest Utah Regional Coal, Round Two
BLM, Salt Lake City, Utah
DEIS, 1983

This document describes the expected impacts of leasing 1.907 billion tons of Federal coal in 25 tracts in central and southern Utah and 2 in west-central Colorado. Of the 82,289.37 acres of overlying surface, only 687 acres (0.008 percent) would be surface mined (in the Emery and Alton coal fields). The Utah leases are in the Book Cliffs, Wasatch Plateau, Emery and Alton Coal Fields. Both Colorado leases are in the Paonia-Somerset coal field. By the year 2,000, 7,500 acre-feet of water (7,000 for community use) would be required annually. In the Book Cliffs and Wasatch Plateau coal fields the coal is in the Cretaceous Blackhawk Formation. In the Emery field, the coal is in the Ferron Sandstone, lower in the Cretaceous section. The coal-bearing zone in the Alton coal field is the Dakota Sandstone. The Colorado coal is in the Cretaceous Mesaverde Formation.

ERTS REGIONAL-SCALE OVERVIEW LINKING LAND USE AND ENVIRONMENTAL PROCESSES IN CARETS
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IN: SYMPOSIUM ON SIGNIFICANT RESULTS OBTAINED FROM THE EARTH RESOURCES TECHNOLOGY SATELLITE-1: VOL I--TECHNICAL PRESENTATIONS, SECT B, GODDARD SPACE FLIGHT CENTER, NEW CARROLLTON, MD, MARCH 5-9, 1973: NATIONAL AERONAUTICS AND SPACE ADMIN REPT NASA SP-327, P 931-937, 1973. 3 FIG, 1 TAB.,
Journal Announcement: SWRA0713

A MOSAIC OF ERTS IMAGES OF THE CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE WAS USED TO PARTITION THE REGION INTO ZONES ON THE BASIS OF SIMILARITY OF TONES AND TEXTURES VISIBLE AT A REGIONAL-SCALE OVERVIEW. THE RESULTING PATTERNS WERE COMPARED WITH EXISTING SMALL-SCALE MAPS OF THE REGION REPRESENTING RELIEF, LAND SURFACE FORMS, GEOLOGY, SOILS, VEGETATION, FOREST TYPES, AND LAND USE. THE ERTS-DERIVED ZONES MOST CLOSELY RESEMBLE THE PATTERNS ON THE SMALL-SCALE LAND USE MAP, SUGGESTING THAT LAND USE IS AN INDICATOR OR RESULTANT SURFACE EXPRESSION OF SEVERAL INTERACTING ENVIRONMENTAL PROCESSES. THESE RESULTS LEND SUPPORT TO A MODEL OF INTERDISCIPLINARY REGIONAL ANALYSIS IN WHICH DATA ON LAND USE AND LAND USE CHANGE BECOME THE BASIC DATA ENTRY INTO A REGIONAL INFORMATION SYSTEM TO (KNAPP-USGS)

Stream quality in Appalachia as related to coal-mine drainage, 1965:
Biesecker, J. E. and George, J. R., 1966.
U.S. Geological Survey Circular 526, 27 p.

A stream-quality reconnaissance at 318 locations in May 1965 offered the first opportunity for a contemporaneous regional collection and appraisal of water-quality data in Appalachia. The results provide a means of regional comparison of the influence of coal-mine drainage on stream quality at approximately median streamflow. The results disclose that the chemical quality of the water at nearly 200 sites did not meet recommended drinking-water standards. At many of these sites, inferior quality was caused by excessive concentrations of solutes commonly associated with coal-mine waters.

Water-quality damage from mine drainage is particularly severe in the more heavily mined northern one-third of the region where high sulfate content, free mineral acidity, and low pH are typical of most affected streams. A deficiency in natural stream alkalinity in this part of the coal region contributed greatly to the massive effect of mine drainage upon stream quality.

However, data collected from streams affected by mine drainage along the west edge of this part of the coal field suggest extensive neutralization of mine water. In southern Appalachian coal-mine drainage had less influence on stream quality than in northern Appalachia. Fewer streams in this area were influenced by mine drainage, and the magnitude of stream damage for affected streams was less than in northern Appalachia. (Author's abstract)

TECHNIQUES FOR QUALITY-OF-WATER INTERPRETATIONS FROM CALIBRATED GEOPHYSICAL LOGS, ATLANTIC COASTAL AREA
BROWN, DONALD L.
GEOLOGICAL SURVEY, NORFOLK, VA. WATER RESOURCES DIV.
GROUNDWATER, VOL 9, NO 4, P 25-38, JULY-AUGUST 1971. 14 P, 14 FIG, 6 TAB, 9 REF.,
Journal Announcement: SWRA0421

IN THE FALL AND WINTER OF 1967-68, A 2,587-FOOT TEST WELL WAS DRILLED AT MOORE'S BRIDGES FILTER PLANT, NORFOLK, VIRGINIA. THE WELL PENETRATED ROCKS OF POST-MIOCENE, LATE AND MIDDLE MIOCENE, LATE EOCENE, AND YOUNGER AGES. EMPIRICAL WATER-QUALITY DATA WERE USED FOR CALCULATION OF GROUNDWATER QUALITY FROM CALIBRATED GEOPHYSICAL LOGS. CHEMICAL ANALYSES OF WATER SAMPLES FROM SEVEN SEPARATE ZONES AT DEPTHS BETWEEN 850 FEET TO 2,500 FEET BELOW SEA LEVEL INDICATE THAT THE WATER TYPE CHANGES FROM A PREDOMINANTLY SODIUM BICARBONATE WATER ABOVE 1,700 FEET TO A SODIUM CHLORIDE WATER IN THE DEEPER ZONES. USING CALIBRATED GEOPHYSICAL LOGS, AN APPROXIMATION OF THE DISSOLVED-SOLIDS AND CHLORIDE CONTENT MAY BE CALCULATED. IN THE TIDEWATER AREA, IF THE SATURATED RESISTIVITY(RO) READING ON THE ELECTRIC LOG IS LESS THAN 25 OHMMETERS THE TOTAL SOLIDS AND CHLORIDE CONTENT OF THE WATER ARE PROBABLY IN EXCESS OF PUBLIC HEALTH STANDARDS FOR POTABLE WATER. AN EMPIRICAL METHOD OF CALCULATING THE QUALITY OF WATER FROM ELECTRIC LOGS IS PRESENTED. (KNAPP-USGS)

GROUND-WATER RESOURCES OF THE EASTERN SHORE OF VIRGINIA AND THE JAMES, YORK, AND RAPPAHANNOCK RIVER BASINS OF VIRGINIA, EAST OF THE FALL LINE
DEBUCHANANNE, GEORGE D.
U. S. GEOLOGICAL SURVEY.
U. S. GEOL. SURV. HYDROL. INVEST. ATLAS HA-284, 2 SHEETS, 1968. TEXT, 3 MAP, 2 TAB, 18 REF.,
Journal Announcement: SWRA6803

INFORMATION FROM A VARIETY OF PUBLISHED AND UNPUBLISHED SOURCES IS COMPILED, AND BROAD INTERPRETATIONS OF EXISTING INFORMATION ARE MADE. THE COASTAL PLAIN IS UNDERLAIN BY UNCONSOLIDATED CRETACEOUS AND YOUNGER SEDIMENTS WHICH DIP SOUTHEAST 20 TO 80 FT PER MILE IN A GRADUALLY THICKENING WEDGE. YIELDS OF WELLS RANGE FROM A FEW GPM TO SEVERAL HUNDRED GPM. MOST OF THE DEVELOPED GROUNDWATER IS FROM ARTESIAN AQUIFERS.

RECHARGE IS ESTIMATED TO BE 1 MGD PER SQUARE MILE. STORAGE CAPACITY RANGES FROM 10 TO 30% OF AQUIFER VOL. ESTIMATED SAFE YIELD OF THE COASTAL PLAIN AQUIFERS IS 4,000 MGD. WATERS FROM THE EOCENE AND CRETACEOUS AQUIFERS ARE GENERALLY OF GOOD CHEMICAL QUALITY FOR MUNICIPAL AND INDUSTRIAL USES. THEY ARE BASICALLY SODIUM BICARBONATE WATERS WITH SOME LOCAL HIGH FLUORIDE CONCENTRATIONS. WATER FROM MIOCENE AND QUATERNARY AQUIFERS GENERALLY HAS MORE IRON THAN THE WATERS OF THE OLDER FORMATIONS. THE ATLAS CONSISTS OF 2 SHEETS WITH 3 MAPS AND 1 CROSS SECTION SCALED 1:500,000 SHOWING GEOLOGY, GROUNDWATER AVAILABILITY, GROUNDWATER USE, AND GROUNDWATER QUALITY. CHEMICAL ANALYSIS DATA ARE COMPILED IN A TABLE. A STRATIGRAPHIC CHART IS INCLUDED. (KNAPP-USGS)

GROUND-WATER RESOURCES OF THE JAMES, YORK, AND RAPPAHANNOCK RIVER BASINS OF VIRGINIA, WEST OF THE FALL LINE
DEBUCHANANNE, GEORGE D.
US GEOLOGICAL SURVEY.
U S GEOL SURV HYDROL INVEST ATLAS HA-283, 1 P, 1968. 2 MAP, 3 TAB, 23 REF.,
Journal Announcement: SWRA6801

THE AVAILABILITY, QUALITY, AND USE OF GROUND WATER IN A 16,700-SQ-MI AREA WEST OF THE FALL LINE ARE DESCRIBED AND SHOWN ON MAPS AT SCALE 1:500,000. THE VALLEY AND RIDGE PROVINCE IN THE WESTERN PART OF THE AREA IS UNDERLAIN BY FOLDED LIMESTONE, DOLOMITE, SANDSTONE, AND SHALE. WATER MOVES FREELY IN SOLUTION CHANNELS DEVELOPED IN THE CARBONATE ROCKS, AND MANY WELLS ARE HIGHLY PRODUCTIVE. THE BLUE RIDGE PROVINCE NEAR THE MIDDLE OF THE AREA IS A STEEP-SIDED RIDGE A FEW MI WIDE BUT MORE THAN 100 MI LONG. EAST OF THE BLUE RIDGE, THE PIEDMONT PROVINCE IS A ROLLING AREA WITH DEEP RESIDUAL SOIL THAT YIELDS ONLY SMALL SUPPLIES OF WATER TO WELLS. TOTAL GROUNDWATER USE IS SMALL, LESS THAN 26 MGD, 20 MGD OF WHICH IS IN THE VALLEY AND RIDGE PROVINCE AND ABOUT .4 MGD IN PIEDMONT. THE GROUNDWATER IS GENERALLY GOOD AND IS SUITABLE FOR PUBLIC SUPPLIES. IN MOST PLACES, WELLS YIELD LESS THAN 100 GPM, BUT SEVERAL HIGH PRODUCTION AREAS ARE NOTED. IN THOSE AREAS, WELLS TAP CARBONATE AQUIFERS OR MULTIPLE PRODUCING ZONES, ARE ADJACENT TO PERENNIAL STREAMS OR SPRINGS, ARE SEVERAL FT IN DEPTH, OR HAVE COMBINATIONS OF ALL THESE FACTORS. WELLS IN THE PIEDMONT SELDOM PRODUCE MORE THAN 75 GPM.

Groundwater Hydrology of James City County, Virginia
Harsh, J. F.
Geological Survey, Richmond, VA. Water Resources Div.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO. 80225, Price: $21.25 in paper copy, $5.50 in microfiche. Geological Survey Open-file Report 80-961 (WRI), September, 1980. 73 p, 22 Fig, 4 Plates, 6 Tab, 32 Ref.,
Journal Announcement: SWRA1414

Urbanization and increase in water demand prompted a 2-year study of groundwater availability and quality in the county of James City. The coastal-plain sediments, parts of which underlie the county, are the largest source of groundwater in Virginia. Four aquifers form the complex aquifer system. Hydraulic characteristics vary from aquifer to aquifer and from place to place. The Cretaceous aquifer furnishes nearly all the water for industrial and municipal needs. Movement of water in the Cretaceous aquifer is toward cones of depression formed by pumping centers at Williamsburg and Dow Badische Co. All aquifers contain water that generally meets State standards for drinking water. Water in the Cretaceous aquifer is of the sodium chloride bicarbonate type. As depth of aquifer increases, the concentrations of dissolved solids and chloride also increase. Saline water (more than 250 milligrams per liter) occupies the deeper parts of the confined aquifers. The amount of water stored in the coastal sediments is estimated to be 650-1300 billion gallons. An increase in pumpage to accomodate the expected daily demand of 9.8 million gallons per day in year 2000 is feasible provided pumpage is distributed over the county. (USGS)

Acid mine drainage (AMD) and its impact on a small Virginia stream
Hoehn, R. C., and Sizemore, D. R., 1977
Water Resources Bulletin, v. 13, no. 1, p. 153-160

Hydrology of area 16, eastern coal province, Virginia, Tennessee, 1981
Hufschmidt, P. W. and others
U.S. Geological Survey Open-File Report 81-204
The coal provinces of the country are divided into hydrologic reporting area. Hydrologic information and sources are presented as text, tables, maps, and other illustrations designed to be useful to mine owners, operators, and consulting engineers in planning and implementing surface-mine operations that comply with the environmental requirements of the "Surface Mining Control and Reclamation Act of 1977."

Hydrogeology of the Observation Well Site at the U.S. Geological Survey National Center, Reston, Virginia
Larson, J. D.
Geological Survey, Reston, VA. Water Resources Div.
Open-file report 78-144, 1978. 35 p, 9 fig, 4 tab, 8 ref. append.,
Journal Announcement: SWRA1120
The U.S. Geological Survey's National Center is on a 105-acre tract straddling rocks of two distinct types. These are pelitic schists of late Precambrian or early Paleozoic age; and sandstone, shale, siltstone, conglomerate, and diabase

of Triassic age. Two observation wells and two core holes were drilled on the part of the property underlain by Triassic sedimentary rocks. The wells were drilled to monitor water levels, for equipment testing and to determine the hydraulic properties of the Triassic rocks. Geophysical logs were run and lithologic logs prepared from drill cuttings and cores. An aquifer test was conducted and indicated that the water comes from two thin zones, presumably bedding plane partings. The flowmeter surveys, core samples, and geophysical logs suggest that the Triassic sandstone is a fractured-rock aquifer. A water sample taken at the close of the aquifer test was low in dissolved solids, soft, and of excellent quality. (Woodard-USGS)

Technique for estimating magnitude and frequency of floods in Virginia
Miller, E. M., 1978
U.S. Geological Survey Water Resources Investigation 78-d, 83 p., 2 plates.

Map Showing Drainage Basins and Location of Streamflow-Measuring Sites, Fairfax County, Virginia
Mohler, E. H.
Geological Survey, Reston, VA. Water Resources Div.
Open-file report 77-270, 1977. 1 sheet, 2 ref.,
Journal Announcement: SWRA1106
A drainage basin map of Fairfax County shows basins for named streams with drainage areas of 1.1 sq mi (2.8 sq km) or more. Areas of minor streams draining directly into the Potomac River and Occoquan Creek are tabulated. The locations of continuous-record and partial-record (peak-flow and low-flow) flow sites are shown. The use of topographic and climatic characteristics of drainage basins to transfer flow data from gaged areas to ungaged areas is discussed. (Woodard-USGS)

Water Resources of the Appalachian Region: Pennsylvania to Alabama, 1965
Musser, J. J.
U.S. Geological Survey Hydrologic Investigation Atlas Ha-198, Sheet 9.
Acid streams in the Appalachian region are identified and discussed, and the amount of acidity as H2SO4 discharged annually into several streams is tabulated.

Virginia streamflow data program analysis
Nuckles, E. H., 1970
U. S. Geological Survey Open-File Report, 54 p.

Quality of surface water in the coal mining area of southwest Virginia, 1980
Rogers, Stanley M., and Hoffschmidt, P. W. U.S. Geological Survey Water Resources Investigations Open-File Report 80-769, 2 sheets.

Flood of April 1977 in the Appalachian region of Kentucky, Tennessee, Virginia, and West Virginia, 1980
Runner, G. S. and Chin, E. H.
U.S. Geological Survey Professional Paper 1028
Heavy rains fell over the Appalachian region of Kentucky, Tennessee, Virginia, and West Virginia April 2-5, 1977, causing record flooding. Rainfall amounts of 4 to 15.5 inches were observed. The maximum amount of 15.5 inches occurred at Jolo, West Virginia, in about 30 hours. This was more than twice the amount which would be expected for a 100-year recurrence-interval storm. Flood discharges along the upper Guyandotte River; Tub Fork, and Levisa Fork in the Big Sandy River basin; Cumberland River; and Clinch River and Dowell River in the Tennessee River basin exceeded those previously known. Severe flooding also occurred along the Holston River and along the North Fork Kentucky River. Recurrence intervals of observed flood discharges were greater than 100-years at 29 streamflow measurement sites. Substantial reductions in peak stages and discharges on Levisa Fork, North Pound River, and Guyandotte River, attained as a result of reservoir storage, were reported by U.S. Army Corps of Engineers. Maximum daily suspended-sediment discharges on Guyandotte River near Baileysville, West Virginia, and Tug Fork at Glenhays, West Virginia, were 54,800 tons/day and 290,000 tons/day, respectively, April 5, 1977. Twenty-two lives were lost and total property damage reportedly exceeded $400 million in the four-state area.

An interim report on the investigation of flooding in the Tug Fork basin of Kentucky, Virginia, and West Virginia, 1980
Scott, A. G.
U.S. Geological Survey, Water-Resources Investigation, Open-File Report 80-1188, p. 116
An analytical plan is presented for a study of the effects of land-use changes on the magnitude and frequency of flood-peak flows and on sediment characteristics of the Tug Fork in Kentucky, Virginia, and West Virginia. The plan includes compilation and analysis of available data, collection of new data on small, single land-use drainage areas for deterministic computer modeling, and creation of a computer model of the Tug Fork basin for definition of cumulative land-use impacts.

Also presented is a compilation of the available hydrologic data and a description of related studies expected to provide information and data useful to the on-going work. The data compilation includes: Hourly precipitation for selected days and annual maximum daily precipitation for nine sites, annual maximum streamflow rates and stages for three stream-gaging sites, hourly gageheight and discharge rates for selected storms at four stream-gaging sites, flood profiles, flood-frequency relations, and other streamflow information.

GROUND-WATER RESOURCES OF ACCOMACK AND NORTHAMPTON COUNTIES, VIRGINIA
SINNOTT, ALLEN; CHASE, G.; TIBBITTS, JR
U. S. GEOLOGICAL SURVEY.
VIRGINIA DEP OF CONSERV AND ECON DEVELOP, DIV OF MINERAL RESOURCES, REP 9, 1968. 113 P, 7 FIG, 4 PLATE, 8 TAB, 25 REF.,
Journal Announcement: SWRA0201

GROUNDWATER RESOURCES OF ACCOMACK AND NORTHAMPTON COUNTIES, IN THE VIRGINIA PART OF THE DELMARVA PENINSULA, WERE STUDIED BY THE USGS AND THE VIRGINIA DIVISION OF MINERAL RESOURCES. MEAN ANNUAL TEMPERATURE IS 58 DEG AND THE PRECIPITATION IS 43 IN. THIN SURFICIAL PLEISTOCENE SANDS, AND CLAYS ARE UNDERLAIN BY MIOCENE DEPOSITS WHICH SUPPLY MOST OF THE WATER FOR MUNICIPAL AND INDUSTRIAL USES. CHEMICAL CHARACTER OF THE DEEPER WATER SUGGESTS HYDRAULIC CONNECTION WITH THE ARTESIAN AQUIFERS EAST OF CHESAPEAKE BAY. DOMESTIC WATER IS MAINLY FROM WELLS IN THE PLEISTOCENE DEPOSITS. LARGER WELLS ARE MAINLY IN MIOCENE AQUIFERS; ONE NEAR EXMORE YIELDED 746 GPM WITH 37 FT OF DRAWDOWN, AND ONE AT CAPE CHARLES YIELDS 645 GPM. THE WATER IS GOOD, MODERATELY HARD, AND USUALLY LOW IN IRON AND FLUORIDE. DEEP MIOCENE WELLS YIELD WATER HIGH IN BICARBONATE AND FAIRLY HIGH IN CHLORIDE. WITHDRAWAL IS NOT EXCESSIVE ANYWHERE AND THE SUPPLY IS ADEQUATE FOR FORESEEABLE NEEDS. WELL DESCRIPTIONS, AQUIFERS, WATER LEVELS, YIELDS, AND CHEMICAL ANALYSES ARE TABULATED. MAPS, CROSS SECTIONS AND A STRATIGRAPHIC COLUMN SHOW WELL LOCATION, GEOLOGY, AND STRATIGRAPHY. (KNAPP-USGS)

Geohydrologic Reconnaissance of the Upper Potomac River basin
Trainer, Frank W., and Watkins, F. A., Jr., 1975
U.S. Geological Survey Water Supply Paper 2035, 68 p.

Mineral resources of the Appalachian region
U.S. Geological Survey and U.S. Bureau of Mines, 1968
U.S. Geological Survey Professional Paper 580, 494 p.

Water Resources Data for Virginia, published annually since 1975.
Geological Survey, Richmond, VA. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161.

Water resources data for Virginia consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Virginia. (USGS)

WATER RESOURCES INVESTIGATIONS IN VIRGINIA, 1969
GEOLOGICAL SURVEY, WASHINGTON, D.C.
GEOLOGICAL SURVEY REPORT OF INVESTIGATIONS FOLDER, 1 SHEET, 1969. 4 FIG, 1 MAP.,
Journal Announcement: SWRAUS21

THE WATER RESOURCES STUDIES AND INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN VIRGINIA ARE SUMMARIZED. A SELECTED BIBLIOGRAPHY OF MATERIAL CONCERNING THE STATE IS INCLUDED. A LIST IS GIVEN OF STATE AND FEDERAL AGENCIES, COUNTIES, AND CITIES WHO COOPERATE IN DIFFERENT PARTS OF THE PROGRAM. THE HYDROLOGIC DATA NETWORK CONSISTS OF 173 PRIMARY, SECONDARY, AND WATER MANAGEMENT STREAMFLOW STATIONS; 64 GROUNDWATER OBSERVATION WELLS; AND 21 WATER QUALITY OBSERVING SITES. SMALL STATE MAPS SHOW PRINCIPAL SOURCES OF GROUNDWATER, DISCHARGE OF THE PRINCIPAL RIVERS, AVERAGE ANNUAL PRECIPITATION, AND AVERAGE ANNUAL RUNOFF. A MAP, SCALE 32 MI TO THE INCH, SHOWS BY SYMBOLS, NUMBERS, AND COLORED OUTLINE THE HYDROLOGIC DATA NETWORK AND INVESTIGATIONS IN VIRGINIA IN JULY 1969. (WOODARD-USGS)

Ground-water resources of the Appalachian region
Wyrick, Granville, G., 1968
U.S. Geological Survey Hydrologic Investigations Atlas HA-295, 4 sheets.

Water Resources of the Guyandotte River basin, West Virginia.
Bader, J. S., Chisholm, J. L., Bragg, R. L., and Downs, S. C., 1980
U.S. Geological Survey Bulletin 7.

Hydrologic Data for the Guyandotte River Basin, West Virginia.
Bader, John S., Chisholm, James L., Downs, Sanford C., and Bragg, Robert L.
U.S. Geological Survey Basic Data Report - 7.

Ground-Water Hydrology of the Guyandotte River Basin, West Virginia.
Bader, J. S.
U.S. Geological Survey Atlas, 1 Sheet, 6 Illus. 5 Tables, 16 Ref.

Water Resources of the Coal River Basin, West Virginia
Bader, J. S., Chisholm, J. L., Downs, S. C., and Morris, F. D., 1976
U.S. Geological Survey Bulletin no. 5.

Stream Quality in Appalachia as Related to Coal-Mine Drainage, 1965. (Duplicated see Alabama and Pennsylvania)
Biesecker, J. E., and George, J. R.
U.S. Geological Survey Circular 526.

Effects of deep and surface coal mining on the hydrologic environment of selected stream basins in southern West Virginia
Borchers, J. W., Ehlke, T. A., Mathes, M. V., and Downs, S. C., 1983
U.S. Geological Survey Water Resources Investigations Report, (In Preparation).

Geology and Economic Resources of the Ohio River Valley in West Virginia.
Carlston, Charles W., and Graeff, George D., Jr.
U.S. Geological Survey

Stress and Recovery of Aquatic Organisms as Related to Highway Construction Along Turtle Creek, Boone County, West Virginia
Chisholm, J. L.; Downs, S. C.
Geological Survey, Charleston, WV. Water Resources Div.
Available from the Supt. of Documents, GPO, Washington, DC 20402, Price $1.60. Water-Supply Paper 2055, 1978. 40 p, 22 fig, 6 tab, 9 ref.,
Journal Announcement: SWRA1115

During and after construction of Appalachian Corridor G, a divided, four-lane highway in West Virginia, five benthic invertebrate samples were collected at each of four sites on Turtle Creek, and, for comparative purposes, three samples were collected at each of two sites on Lick Creek, an adjacent undisturbed stream. Diversity index, generic count, and total cout initially indicated severe depletion or destruction of the benthos of Turtle Creek, but, within 1 year after highway construction was completed, the benthic community of Turtle Creek was similar to that of Lick Creek. The greatest degradation occurred near the headwaters of Turtle Creek because of erratic movement of sediment resulting from high streamflow velocity. Diversity indices ranged from 0 to 3.41 near the headwaters in the original channel, but only from 0.94 to 2.42 farther downstream in a freshly cut channel. The final samples from Turtle Creek, which were similar to those taken from Lick Creek at the same time, had generic counts of 10 at the most upstream site and 16 near the mouth. A total of 147 organisms was found near the headwaters, whereas a total of 668 was found near the mouth of the stream. The total number of organisms collected at each site was proportional to the drainage area upstream from the site. As a result of tributary inflow from unaltered drainage areas and organism drift, rapid repopulation and stabilization of the benthic community occurred. Channel relocation, bank recontouring, and reseeding also accelerated the recovery of the benthic community. (Woodard-USGS)

Records of Wells, Springs, Chemical Analyses of Water, Biological Analyses of Water, and Standard Streamflow Data Summaries From the Upper New River Basin in West Virginia.
Chisholm, James L., and Frye, Prentis M.
U.S. Geological Survey Basic Data Report No.4.

Water Resources of the Upper New River Basin, West Virginia
Clark, William E., Chisholm, James L., and Frye, Prentis M.
U.S. Geological Survey River Basin Bulletin 4.

West Virginia's Buffalo Creek Flood: A Study of the Hydrology and Engineering Geology
Davies, William E., Bailey, James F., and Kelly, Donovan B.
U.S. Geological Survey Circular 667

Water Resources of Kanawha County, West Virginia
Doll, Warwick L., Wilmoth, Benton M. Jr., Whetstone, George W.
U.S. Geological Survey Bulletin 20.

A Flood Model for the Tug Fork Basin, Kentucky, Virginia, and West Virginia
Doyle, W. Harry Jr., Curwick, Philip B., and Flynn, Kathleen M.
U.S. Geological Survey Water-Resources Investigations Report 83-4014

Surface mining of coal in the United States increased from 406 million tons to almost 800 millions tons from 1978 to 1979. In the coal-rich 1,560-square-mile Tug Fork basin located in Kentucky, Virginia, and West Virginia, there has been a 2,500 percent increase since 1950 in areas affected by surface-mining activities.

This study used a rainfall-runoff model to determine if land-use changes associated with surface mining in the Tug Fork basin have affected basin streamflow characteristics. The model was calibrated and verified for two periods, one representing 1980 land-use and one representing 1950 land-use. Two 29-year synthetic daily streamflow time series representing the two land-use conditions were generated. Statistical tests performed on the two time series at 15 points in the basin showed no difference at the 0.01 percent confidence level at any of the locations.

In addition, analyses were made to determine if future increases in surface-mining activities might affect basin streamflow. One analysis showed that increasing mining in an upland watershed by as much as 200 percent had little effect on streamflow in the intermediate area and no effect on streamflow at downstream locations along the Tug Fork. Even for a scenario where all areas disturbed by mining were assumed totally impervious, the modeling process demonstrated that the increase in mean-annual 1-day high flows (for recurrence intervals of 2, 5, 10, 25, 50, 100, and 200 years) was less than 4 percent at the basin outlet.

Hydrology of Area 12, Eastern Coal Province, West Virginia
Ehlke, T. A., Bader, J. S., Puente, Celso, and Runner, G. S., 1981a
U.S. Geological Survey Water-Resources Investigations Report 81-902, 170 p.

Hydrology of Area 9, Eastern Coal Province, West Virginia
Ehlke, T. A., Runner, G. S., and Downs, S. C., 1981b
U.S. Geological Survey Water-Resources Investigations Report 81-803, 154 p.

FLUVIAL SEDIMENT IN SALEM FORK WATERSHED, WEST VIRGINIA
FLINT, R. F.
GEOLOGICAL SURVEY, WASHINGTON, D.C. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1798-K, 1972. 29 P, 9 FIG, 11 TAB, 23 REF.,
Journal Announcement: SWRA0602

SUSPENDED SEDIMENT DISCHARGED FROM THE 8.32-SQUARE-MILE SALEM FORK STUDY AREA IN HARRISON COUNTY, W. VA., AVERAGED 3,500 TONS PER YEAR DURING THE FIRST 4-YEAR PERIOD OF INVESTIGATION AND 1,770 TONS PER YEAR DURING THE SECOND 4-YEAR PERIOD. THE DIFFERENCE WAS ATTRIBUTED TO INCREASED FLOW CONTROL, EFFECTED BY THE COMPLETION OF DETENTION STRUCTURES AND OTHER

CONSERVATION MEASURES, THE ABSENCE OF APPRECIABLE SEDIMENT-PRODUCING CONSTRUCTION ACTIVITIES, AND A REDUCTION OF THE AMOUNTS OF RAINFALL AND RUNOFF DURING THE SECOND 4-YEAR PERIOD. PARTICLE-SIZE DISTRIBUTION OF THE SUSPENDED SEDIMENT DISCHARGED FROM THE WATERSHED REMAINED UNCHANGED DURING THE TWO 4-YEAR PERIODS. ALTHOUGH SAND AND SOME SILT WERE DEPOSITED IN UPSTREAM RESERVOIRS, SANDS AND OTHER SEDIMENTS WERE ENTRAINED IN THE FLOW BELOW THE RESERVOIRS. (WOODARD-USGS)

RECORDS OF WELLS, SPRINGS, AND TEST BORINGS, CHEMICAL ANALYSES OF WATER, SEDIMENT ANALYSES, STANDARD STREAMFLOW DATA SUMMARIES, AND SELECTED DRILLERS' LOGS FROM THE LITTLE KANAWHA RIVER BASIN IN WEST VIRGINIA
FRIEL, E. A.; BAIN, G. L.
GEOLOGICAL SURVEY, CHARLESTON, W. VA. WATER RESOURCES DIV.
GEOLOGICAL SURVEY BASIC DATA REPORT NO 2, 1971. 76 P, 4 FIG, 12 TAB.,
Journal Announcement: SWRA0509

BASIC DATA ARE PRESENTED FOR THE WATER RESOURCES (SURFACE WATER AND GROUNDWATER) OF THE LITTLE KANAWHA RIVER BASIN IN WEST VIRGINIA. MOST OF THE BASIC DATA WERE OBTAINED DURING THE PERIOD 1966-1969. INCLUDED ARE SUMMARIES OF WATER-BEARING PROPERTIES OF THE PRINCIPAL ROCK UNITS UNDERLYING THE LITTLE KANAWHA BASIN, LABORATORY AND FIELD CHEMICAL ANALYSES OF SURFACE-WATER SAMPLES, INSTANTANEOUS SUSPENDED SEDIMENT ANALYSES AT STREAM-GAGING STATIONS, STREAMFLOW RECORDS OF DAILY DISCHARGE FOR EACH STATION, AND WELL DRILLERS' LOGS. (WOODARD-USGS)

RECORDS OF WELLS, SPRINGS, AND STREAMS IN THE POTOMAC RIVER BASIN, WEST VIRGINIA
FRIEL, E. A.; HOBBA, W. A. JR; CHISHOLM, J. L.
GEOLOGICAL SURVEY, MORGANTOWN, W. VA.
WEST VIRGINIA GEOLOGICAL AND ECONOMIC SURVEY, (MORGANTOWN), BASIC DATA REPORT NO 3, 1975. 96 P, 3 FIG, 10 TAB.,
Journal Announcement: SWRA0915

THIS BASIC DATA REPORT WAS COMPILED FROM WATER-RESOURCES STUDIES OF THE POTOMAC RIVER BASIN IN WEST VIRGINIA. MOST OF THE BASIC DATA WERE OBTAINED DURING THE PERIOD 1968-1971. THE STUDY IS A PART OF THE CONTINUING INVESTIGATION OF THE WATER RESOURCES OF THE RIVER BASINS OF WEST VIRGINIA BY THE U. S. GEOLOGICAL SURVEY, CONDUCTED IN COOPERATION WITH THE WEST VIRGINIA GEOLOGICAL AND ECONOMIC SURVEY AND THE WEST VIRGINIA DEPARTMENT OF NATURAL RESOUCES, DIVISION OF WATER RESOURCES. OTHER INCLUDED DATA ARE FROM THE FILES OF THE U. S. GEOLOGICAL SURVEY OR FROM PREVIOUSLY PUBLISHED REPORTS. THE 10 TABLES OF DATA INCLUDE: (1) RECORDS OF WELLS AND SPRINGS, (2) CHEMICAL ANALYSES OF GROUNDWATER, (3) CHEMICAL ANALYSES OF SURFACE WATER, (4) FIELD CHEMICAL ANALYSES OF SURFACE WATER AT STREAM-GAGING STATIONS, (5) LOW-FLOW MEASUREMENTS AND FIELD CHEMICAL ANALYSES OF SELECTED STREAMS AND SPRINGS, (6) DAILY SPECIFIC CONDUCTANCE AND DISCHARGE OF DILLIONS RUN AT CAPON

BRIDGE, (7) PESTICIDE ANALYSES OF GROUNDWATER, (8) STANDARD SUMMARIES OF STREAMFLOW DATA, (9) DISCHARGE MEASUREMENTS AT PARTIAL-RECORD AND MISCELLANEOUS SITES, AND (10) SELECTED DRILLERS' LOGS. (WOODARD-USGS)

Water Resources of the Monongahela River Basin West Virginia
Friel, E. A., Wilmoth, B. M., Ward, P. E., Wark, J. W.
U.S. Geological Survey

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia, (duplicated see Pennsylvania).
Herb, W. J.; Shaw, L. C.; Brown, D. E.
Geological Survey, Harrisburg, PA. Water Resources Div.
Geological Survey Open-File Report 81-538 (WRI), September 1981. 92 p, 60 Fig, 22 Tab, 37 Ref, Append.,
Journal Announcement: SWRA1511

Investigation of Trends in Flooding in the Tug Fork Basin of Kentucky, Virginia, and West Virginia
Hirsch, R. M.; Scott, A. G.; Wyant, T.
Geological Survey, Reston, VA. Water Resources Div.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.75. Water-Supply Paper 2203, 1982. 37 p, 24 Fig, 16 Tab, 38 Ref, 5 Append.,
Journal Announcement: SWRA1601
Statistical analysis indicates that the average size of annual flood peaks of the Tug Fork (West Virginia and Kentucky) has been increasing. However, additional statistical analysis does not indicate that flood levels exceeded typically once or twice a year in the period 1947-1979 are any more likely to be exceeded now than in 1947. Possible trends in stream-channel size are also investigated at three locations. No discernible trends in channel size are noted. Further statistical analysis of the trend in the size of annual flood peaks shows that much of the annual variation is related to local rainfall and to the 'natural' hydrologic response in a relatively undisturbed subbasin. However, some statistical indication of trend persists after accounting for these natural factors, though it is of borderline statistical significance. This suggests the need for further study in the basin that may relate flood magnitudes to both rainfall and to land use. (USGS)

Coal mines as a source of water for public supply in Upshur County, West Virginia.
Hobba, W. A., Jr., 1983
U.S. Geological Survey Open-File Report, (In Preparation).

Ground-Water Hydrology of the Little Kanawha River Basin, West Virginia
Hobba, W. A. Jr.

U.S. Geological Survey Map WV-10.

Effects of Underground Mining and Mine Collapse on the Hydrology of Selected Basins in West Virginia
Hobba, William A. Jr.
U.S. Geological Survey, Report of Investigation RI-33, 84 p. (Published in STOP format).

The effects of underground mining and mine collapse on areal hydrology were determined at one site where the mined bed of coal lies above major streams, and at two sites where the bed of coal lies below major streams. Subsidence cracks observed at land surface generally parallel predominant joint sets in the rocks. The mining and subsidence cracks increase hydraulic conductivity and interconnection of water-bearing rock units, which in turn cause increased infiltration of precipitation and surface water, decreased evapotranspiration, and higher base flows in some small streams. Water levels in observation wells in mined areas fluctuate as much as 100 feet annually. Both gaining and losing streams are found in mined areas. Mine pumpage and drainage can cause diversion of water underground from one basin to another. Areal and single-well aquifer tests indicated that near-surface rocks have higher transmissivity in a mine-subsided basin that in unmined basins. Increased infiltration and circulation through shallow subsurface rocks increases dissolved mineral loads in streams, as do treated and untreated contributions from mine pumpage and drainage. Abandoned and flooded underground mines make good reservoirs because of their increased transmissivity and storage. Subsidence cracks were not detectable by thermal imagery, but springs and seeps were detectable.

Water Resources of the Potomac River Basin, West Virginia
Hobba, W. A. Jr; Friel, E. A.; Chisholm, J. L.
Geological Survey, Morgantown, WV. Water Resources Div.
West Virginia Geological and Economic Survey River Basin Bulletin 3, 1977. 110 p, 48 fig, 3 plates, 30 tab, 56 ref.,
Journal Announcement: SWRA1214

This report presents basic information and interpretations regarding the occurrence, availability, and quality of the water resources of the Potomac River basin in West Virginia. The basin includes an area of 3,464 square miles or about 15 percent of the State. The present population is 125,500. Considerable future increases in population, with increases in recreational and industrial expansion, are anticipated. Thus, a knowledge of the water resources is essential in proper planning for development. Virtually all water in the basin is derived from precipitation. Average annual precipitation is 38 inches per year; of this amount 25 inches is returned to the atmosphere by evapotranspiration, 8 inches becomes ground-water recharge, and 5 inches becomes direct overland runoff. Average annual streamflow is 0.9 cubic feet per second per square mile. The carbonate rocks of Berkeley and Jefferson Counties are the best aquifers and may yield more than 600 gallons per minute to individual wells tapping cavernous zones. The shale rocks of the central part are generally the poorest aquifers. The chemical quality of both surface water and ground water is very poor to excellent, depending on location. (Woodard-USGS)

Abandoned Coal Mines in West Virginia as Sources of Water Supplies.
Lessing, Peter, and Hobba, William A. Jr.
U.S. Geological Survey Circular Number C-24
Water from underground coal mines may not be the best source for every community's water supply, but it could be considered and evaluated along with other possible sources. Water from coal mines may prove useful, even if only a backup public supply, to augment low-flow in streams, and possibly for agriculture or power plants. Considering the large quantities of mine water available throughout the State, its potential benefits could be explored. It may prove to be an excellent inexpensive water supply.

Hydrologic Data for the Coal River Basin, West Virginia
Morris, F. O.; Bader, J. S.; Chisholm, J. L.; Downs, S. C.
Geological Survey, Morgantown, WV. Water Resources Div.
West Virginia Geological and Economic Survey Basic Data Report No. 5, 1976. 215 p, 11 tab.,
Journal Announcement: SWRA1222
During 1973-1975, the U.S. Geological Survey collected hydrologic data to describe the character of the ground- and surface-water resources of the Coal River basin in southern West Virginia. Streamflow and chemical, physical, and biological data were collected at about 15 stream sites. Descriptive data were collected at about 450 well sites and water samples from nearly 400 of them were analyzed for chemical and physical properties. The chemical composition of surface water at the time of low flow and moderate flow was determined for about 115 small streams. (Woodard-USGS)

Hydrologic modeling in selected small watersheds in the coal areas of West Virginia.
Puente, C., and Atkins, J. T., 1983.
U.S. Geological Survey Water Resources Investigation Report, (In Preparation).

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia
Roth, D. K.; Engelke, M. J. Jr
Geological Survey, Columbus, OH. Water Resources Div.
Geological Survey Open-File Report 81-343 (WRI), July, 1981. 62 p, 41 Ref, 3 Append.,
Journal Announcement: SWRA1511
Area 4 (one of the 24 hydrologic areas defining the

Eastern Coal Province) is located at the northern end of the Eastern Coal Province in eastern Ohio, northern West Virginia, and western Pennsylvania. It is part of the upper Ohio River basin, which includes the Beaver, Mahoning, and Shenango Rivers. The area is underlain by rocks of the Pottsville, Allegheny, Conemaugh, Monongahela Groups (or Formations) and Dunkard Group. Area 4 has a temperate climate with an annual average rainfall of 38 to 42 inches, most of its area is covered by forest. The soils have a high erosion potential where the vegetation cover is removed. In response to Public Law 95-87, 132 sites were added to the existing surface-water data-collection network in area 4. At these added sites, collected data includes discharge, water quality, sediment, and biology. The data are available from computer storage through the National Water Data Exchange (NAWDEX) or the published annual Water Resources Data reports for Ohio, Pennsylvania, and West Virginia. Hydrologic problems related to mining are: (1) Erosion and increased sedimentation, and (2) degradation of water quality. Erosion and sedimentation are associated chiefly with surface mining. Sediment yields increase drastically when vegetation is removed from the highly erosive soils. Degradation of water quality can be caused by acid-mine drainage from underground and surface mining. More than half the acid-mine drainage effluent in area 4 comes from underground mines. The rest seeps from abandoned surface mines. Usually in reclaimed surface mines the overburden is replaced in such a short time after the coal is taken out that oxidation of acid-forming minerals, commonly pyrite or marcasite, is not complete or is neutralized by the buffering action of calcareous minerals in the soils. (USGS)

FLOOD ON BUFFALO CREEK FROM SAUNDERS TO MAN, WEST VIRGINIA
RUNNER, G. S.
GEOLOGICAL SURVEY, RESTON, VA.
FOR SALE BY US GEOL. SURVEY, RESTON, VA 22092 - PRICE $1.50 PER SET. HYDROLOGIC INVESTIGATIONS ATLAS HA-547, 1974. 2 SHEETS, 13 FIG, 4 TAB, 2 REF.,
Journal Announcement: SWRA0817

ON FEBRUARY 26, 1972, AT APPROXIMATELY 8 A.M., A COAL MINE REFUSE DAM COLLAPSED ON MIDDLE FORK, A TRIBUTARY TO BUFFALO CREEK, WEST VIRGINIA. THIS 1-SHEET HYDROLOGIC ATLAS REPORT DOCUMENTS THE HYDROLOGIC EVENTS ASSOCIATED WITH THE BUFFALO CREEK DISASTER AS AN AID IN PLANNING REMEDIAL MEASURES TO REDUCE POTENTIAL FLOOD HAZARDS FROM SIMILAR DAMS AND IMPOUNDMENTS. THIS MOST DESTRUCTIVE FLOOD IN WEST VIRGINIA'S HISTORY SWEPT THROUGH 15.3 MILES OF THE BUFFALO CREEK VALLEY AT AN AVERAGE SPEED OF 7 FEET PER SECOND (5 MILES PER HOUR) AND REACHED THE TOWN OF MAN AT THE MOUTH OF BUFFALO CREEK AROUND 11 A.M. THE TRAVEL TIME FOR THE 15.3 MILES WAS ABOUT 3 HOURS. DURING THE 3-HOUR CASCADE DOWN THE VALLEY AT LEAST 118 LIVES WERE LOST, 500 HOMES WERE DESTROYED, 4,000 PEOPLE WERE LEFT HOMELESS, PROPERTY DAMAGE EXCEEDED $50 MILLION AND HIGHWAY DAMAGE EXCEEDED $15

MILLION. (KNAPP-USGS)

West Virginia Department of Highways Research Project 16 "Runoff Studies on Small Drainage Areas" (Technique for Estimating Magnitude and Frequency of Floods in West Virginia)
Runner, G. S.
U.S. Geological Survey
A technique is presented for estimating the magnitude and frequency of floods on unregulated, virtually natural streams in West Virginia. Multiple-regression techniques were used to develop relations between dependent variables, flood peaks, and independent variable, drainage areas. Data collected at 170 stream-gaging sites were used in the analyses.
Analyses of all residuals errors indicated that the best estimate of flood peaks could be made by dividing the state into three regions.
Peak discharges can be estimated for drainage areas from about 0.3 square mile up to 2000 square miles. Graphs are provided to estimate the flood peak having recurrence intervals of 2, 5, 10, 25, 50, 100, and 500 years and drainage areas between 1 and 1000 square miles. For drainage areas less than 1 and greater than 1,000 square miles peak flows can be estimated using equations listed on each graph.

Ground-Water Hydrology of the Upper New River Basin, West Virginia
Shultz, R. A.
U.S. Geological Survey
This atlas report describes the ground-water resources of the upper New River basin in West Virginia based on three earlier reports on the hydrology of the same basin. The basin drains 2,570 square miles in southeastern West Virginia and extends from the northernmost edge of Pocahontas County to the southwest edge of Mercer County. Precipitation is the principal source of ground-water recharge, averaging close to 40 inches basinwide and ranging from more than 44 inches in the northwestern part to less than 36 inches in the southeastern part. The yield of wells ranges from 0.5 to 500 gallons per minute and varies with topographic location, geologic structure, and geologic unit. Hilltop wells and a few hillside wells may fail to supply enough water for domestic use. Wells in valleys generally yield the greatest amounts of water. The chemical quality of the ground water ranges widely, but is generally good for most uses. In places, it is subject to problems resulting from excessive concentrations of hardness, iron, and manganese.

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980, (duplicated see Maryland).
Staubitz, W. W.
Geological Survey, Towson, MD. Water Resources Div.

Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $13.75, Microfiche $3.50. Geological Survey Open-File Report 81-812, August, 1981. 103 p, 1 Fig, 6 Tab, 7 Ref.,
Journal Announcement: SWRA1510

Hydrologic Data for the Elk River Basin, West Virginia
Tarver, George R., Downs, Sanford C, Chisholm, James L., and Frye Prentis M.
U.S. Geological Survey Basic Data Report Number 6

GEOHYDROLOGIC RECONNAISSANCE OF THE UPPER POTOMAC RIVER BASIN
TRAINER, F. W.; WATKINS, F. A. JR
GEOLOGICAL SURVEY, RESTON, VA.
AVAILABLE FROM SUPT OF DOCUMENTS, GPO, WASHINGTON, DC 20402, PRICE $1.95. WATER-SUPPLY PAPER 2035, 1975. 68 P, 16 FIG, 1 PLATE, 10 TAB, 53 REF.,
Journal Announcement: SWRA0823

THE UPPER POTOMAC RIVER BASIN, IN THE CENTRAL APPALACHIAN REGION IN PENNSYLVANIA, MARYLAND, VIRGINIA, AND WEST VIRGINIA, IS A HUMID TEMPERATE REGION OF DIVERSE FRACTURED ROCKS. THREE GEOHYDROLOGIC TERRANES, WHICH UNDERLIE LARGE PARTS OF THE BASIN, ARE DESCRIBED IN TERMS OF THEIR AQUIFER CHARACTERISTICS AND OF THE MAGNITUDE AND DURATION OF THEIR BASE RUNOFF: (1) FRACTURED ROCK HAVING A THIN REGOLITH, (2) FRACTURED ROCK HAVING A THICK REGOLITH, AND (3) CARBONATE ROCK. CRYSTALLINE ROCK IN THE MOUNTAINOUS PART OF THE BLUE RIDGE PROVINCE AND SHALE WITH TIGHT SANDSTONE IN THE FOLDED APPALACHIANS ARE COVERED WITH THIN REGOLITH. WATER IS STORED IN AND MOVES THROUGH FAIRLY UNMODIFIED FRACTURES. AVERAGE TRANSMISSIVITY (T) IS ESTIMATED TO BE 150 SQ FEET PER DAY, AND AVERAGE STORAGE COEFFICIENT (S), 0.005. CRYSTALLINE AND SEDIMENTARY ROCKS IN THE PIEDMONT PROVINCE AND IN THE LOWLAND PART OF THE BLUE RIDGE PROVINCE ARE COVERED WITH THICK REGOLITH. ESTIMATED AVERAGE VALUES FOR AQUIFER CHARACTERISTICS AR T, 200 SQ FEET PER DAY, AND S, 0.01 . CARBONATE ROCK, IN WHICH FRACTURES HAVE BEEN WIDENED SELECTIVELY BY SOLUTION, ESPECIALLY NEAR STREAMS, HAS ESTIMATED AVERAGE AQUIFER CHARACTERISTICS OF T, 500 SQ FEET PER DAY, AND S, 0.03-0.04. THIS ROCK IS THE MOST EFFECTIVE IN THE BASIN IN TERMS OF WATER SUPPLY AND BASE RUNOFF. ACIDIC MINE-DRAINAGE WATER, LOCAL HIGHLY MINERALIZED GROUNDWATER, AND THE HIGH NITRATE CONTENT OF GROUNDWATER IN SOME AREAS WOULD PROBABLY HAVE LITTLE ADVERSE AFFECT ON THE USE OF GROUNDWATER FOR LOW-FLOW AUGMENTATION. (WOODARD-USGS)

GROUND-WATER HYDROLOGY OF THE MONOGAHELA RIVER BASIN IN WEST VIRGINIA
WARD, PORTER E.; WILMOTH, BENTON M.
U S GEOLOGICAL SURVEY.
WEST VIRGINIA GEOL AND ECON SURV, RIVER BASIN BULL 1, 54 P, 1968. 22 FIG, 6 TAB, 38 REF.,

Journal Announcement: SWRA0203

ADEQUATE SUPPLIES OF GROUNDWATER ARE AVAILABLE IN THE MONOGAHELA BASIN TO MEET PRESENT AND FUTURE REQUIREMENTS. THE BEST SOURCES ARE WELLS IN BEDROCK, PARTICULARLY IN SANDSTONE. THE MOST FAVORABLE AREAS ARE UNDERLAIN BY ROCKS OF THE POTTSVILLE GROUP, ALLEGHENY GROUP, GREENBRIER LIMESTONE, AND THE POCONO FORMATION. YIELDS OF 50-350 GPM ARE COMMON IN MOST AREAS. THE DUNKARD GROUP YIELDS ONLY ABOUT 21 GPM; DEVELOPMENT OF WATER SUPPLIES IN ITS OUTCROP AREA IS DIFFICULT, REQUIRING INTENSIVE INVESTIGATION AND TEST DRILLING. ALLUVIUM IS TOO THIN AND AREALLY RESTRICTED FOR LARGE GROUNDWATER DEVELOPMENT. WATER QUALITY IS GENERALLY GOOD, WITH HIGH IRON, HARDNESS, AND HYDROGEN SULFIDE CONCENTRATION IN A FEW PLACES. SOME SALTY WATER IS FOUND BELOW 100-300 FT IN THE WESTERN PART OF THE BASIN. SOME OILFIELD, MUNICIPAL, HOUSEHOLD, AND CHEMICAL POLLUTION OCCURS IN A FEW AREAS. COAL-MINE ACID POLLUTION HAS A SMALL EFFECT GENERALLY, BUT IN SOME POPULATED AREAS IT IS A DIFFICULT PROBLEM. DESCRIPTIONS OF GEOLOGIC UNITS AND THEIR WATER-BEARING PROPERTIES ARE TABULATED. GEOLOGY, WATER POTENTIAL, AND WATER QUALITY ARE SHOWN BY MAPS. (KNAPP-USGS)

Techniques for estimating streamflow characteristics in the eastern and interior coal provinces

Wetzel, Kim L., and Bettandorff, James M., 1982

U.S. Geological Survey Water-Supply Paper.

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas

Geological Survey, Charleston, WV. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-159674, Price codes: A11 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WV-80-A, October, 1981. 228 p, 9 Fig, 8 Tab.,

Journal Announcement: SWRA1510

Water resources data for the 1980 water year for coal regions of West Virginia consist of discharge and water-quality records collected during two sampling periods at 369 sites. Also included are sediment data from 26 sites. Data were collected as a part of the statewide Coal Hydrology project. (USGS)

Water Resources Data for West Virginia, Water Year 1979. Appendix - Coal Areas

Geological Survey, Charleston, WV. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-154329, Price codes: A13 in paper copy, A01 in microfiche. Geological Survey Water-Data Report

WV-79-A, November, 1980. 287 p, 15 Fig, 8 Tab.,

Journal Announcement: SWRA1509

Water resources data for the 1979 water year for coal regions of West Virginia consist of records of discharge and water quality of streams, wells, mines, and abandoned mine shafts; and water levels in wells and abandoned mine shafts. Section one consists of data obtained for the statewide Coal Hydrology Monitoring Project and includes discharge and water-quality data collected during two sampling periods at 361 sites. Section two consists of data obtained for the Mining Effects Research Project in five small basins in southwestern West Virginia during the period February 1976 to January 1980 and includes records of water quality for 53 stream sampling sites, 52 well sampling sites, 31 mine-discharge sampling sites, and 2 mine-shaft sampling sites; and water levels in 6 wells and 2 mine shafts. (USGS)

Water Resources Data for West Virginia, published annually since 1975

Geological Survey, Charleston, WV. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161.

Water resources data for West Virginia consist of records of stage, discharge, and water quality of streams and springs; stage and contents of lakes and reservoirs; and water levels in wells. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in West Virginia. (USGS)

Present and Potential Sediment Yields in the Yampa River Basin, Colorado and Wyoming, (Duplicated see Colorado).
Andrews, E. D.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-292 677, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-105, December 1978. 33 p, 10 fig, 4 tab, 32 ref.,
Journal Announcement: SWRA1214

Mining and alluvial valley floors
Armentrout, G. W., Jr., 1978
Star-Tribune, Casper, Wyoming, February 23, 1978

Ground-Water Levels in Wyoming, 1974
Ballance, Wilbur C., and Freudenthal, Pamela B.
Geological Survey, Wyoming, Water Resources Div.
Unnumbered Open-File Report, 1975
Ground-water levels are measured periodically throughout Wyoming in an observation-well network by the U.S. Geological Survey in cooperation with the Wyoming State Engineer and the city of Cheyenne. Water-level measurements provide information on the status of the ground-water supply and facilitate prediction of trends in water levels, which indicate change in ground-water storage. During 1974, about 1,500 measurements were made. Net water-level changes were computed, using about 235 measurements made during the first 4 months of 1974 and 1975. Tables of well history, highest and lowest water levels, net changes, and hydrographs for most wells are included in this report.

Ground-Water Levels in Wyoming, 1975
Ballance, Wilbur C., and Freudenthal, Pamela B.
Geological Survey, Wyoming, Water Resources Div.
Open-File Report 76-598, 1976, 173 P, 21 Illus., 4 Ref.
Ground-water levels are measured periodically in a network of about 260 observation wells in Wyoming to record changes in ground-water storage. The areas of water-level observation are mostly where ground water is used in large quantities for irrigation or municipal purposes. This report contains maps showing location of observation wells and water-level changes from 1975 to 1976. Well history, highest and lowest water levels, and hydrographs for most wells are also included in this report.

Ground-Water Levels in Wyoming, 1976
Ballance, Wilbur C., and Freudenthal, Pamela B.
Geological Survey, Wyoming, Water Resources Div.
Open-File Report 77-686, 1977.

Ground-water levels are measured periodically in a network of about 280 observation wells in Wyoming to record changes in ground-water storage. The areas of water-level observation are mostly where ground water is used in large quantities for irrigation or municipal purposes. This report contains maps showing location of observation wells and water-level changes from 1976 to 1977. Well history, highest and lowest water levels, and hydrographs for most wells are also included in this report.

Geology and ground-water resources of the Rawlins area, Carbon County, Wyoming
Berry, D. W., 1960
U.S. Geological Survey Water-Supply Paper 1458, 74 p.

Reconnaissance of the geology and ground-water resources of the Cokeville area, Lincoln County, Wyoming
Berry, D. W., 1955
U.S. Geological Survey Open-File Report.

Geologic map and coal sections of the Pats Bottom quadrangle, Carbon county, Wyoming
Blanchard, L. F., and Comstock, M. C., 1980
U.S. Geological Survey Open-File Report 80-52, 2 sheets, scale 1:24,000.

WATER-QUALITY DATA FOR THE FLAMING GORGE RESERVOIR AREA, UTAH AND WYOMING, 1969-72
BOLKE, E. L.; WADDELL, K. M.
GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
GEOLOGICAL SURVEY OPEN-FILE REPORT (DUPLICATED AS UTAH BASIC-DATA RELEASE NO 24), 1972. 50 P, 1 FIG, 6 TAB, 7 REF.,
Journal Announcement: SWRAU609

SAMPLES FOR CHEMICAL QUALITY ANALYSIS WERE COLLECTED FROM FLAMING GORGE RESERVOIR IN UTAH AND WYOMING BETWEEN OCTOBER 1970 AND SEPTEMBER 1972 AT 17 SITES. CHEMICAL AND PHYSICAL DATA WERE MEASURED IN SITU AT 34 SITES. THE CHEMICAL-QUALITY DATA FOR THE 1969-71 WATER YEARS FOR STREAMS FLOWING INTO AND OUT OF THE RESERVOIR ALSO ARE TABULATED. THE SAMPLING STATIONS FOR THESE STREAMS ARE GREEN RIVER NEAR GREEN RIVER, WYO., BLACKS FORK

NEAR LITTLE AMERICA, WYO., HENRYS FORK AT LINWOOD, UTAH, AND GREEN RIVER NEAR GREENDALE, UTAH. IN ADDITION TO THE GEOLOGICAL SURVEY STATION IDENTIFICATION NUMBER, EACH STREAM SITE HAS BEEN ASSIGNED A LETTER TO IDENTIFY ITS POSITION ON A MAP. (WOODARD-USGS)

Geohydrologic reconnaissance and measurement of perennial streams crossing outcrops of the Madison Limestone, northeastern Wyoming, 1974
Boner, F. C., Lowry, M. E., Lines, G. C., and Powell, J. E., 1976
U.S. Geological Survey Open-File Report 75-614, 63 p.

Preliminary digital model of the Arikaree aquifer in the Sweetwater River basin, central Wyoming
Borchert, W. B., 1977
U.S. Geological Survey Water-Resources Investigations Open-File Report 77-107.

Geology and ground-water resources of the Upper Niobrara River Basin, Nebraska, and Wyoming with a section on Chemical quality of the ground water by F. H. Rainwater
Bradley, Edward, 1956
U.S. Geological Survey Water-Supply Paper 1368.

Correlation of paleostructure and sediment deposition in the Madison Limestone and associated rocks in parts of Montana, North Dakota, South Dakota, Wyoming, and Nebraska
Brown, D. L., Blankennagel, R. K., MacCary, L. M., and Peterson, J. A., 1982
U.S. Geological Survey Open-File Report 82-906, 34 p.

Hydrogeologic features of the alluvial deposits in the Nowood River drainage area, Bighorn Basin, Wyoming
Cooley, M. E., and Head, W. J., 1979
U.S. Geological Survey Water-Resources Investigations Open-File Report 79-1291.

Hydrologic features of the alluvial deposits in the Owl Creek valley, Bighorn Basin, Wyoming
Cooley, M. E., and Head, W. J., 1979
U.S. Geological Survey Water-Resources Open-File Report

Analysis of Runoff from Small Drainage Basins in Wyoming
Craig, Gordon S., Jr., and Rankl, James G.
Geological Survey, Wyoming, Geological Survey Water-Supply Paper 2056, 1977, 113 P, 31 Illustrations, 15 Tables, 24 Ref.

A rainfall-runoff model was used to synthesize long-term records of runoff volume and peak discharge from long-term records (73 years) of rainfall and evaporation. The long-term data was transferred from a base station, Cheyenne, Wyoming, to 13 other weather stations in Wyoming. Volume and peak discharge frequencies were developed for the intermontane areas on 22 drainage basins smaller than 11 square miles relative to rainfall at the nearest weather station. Runoff volumes and peak discharges were related to basin parameters with a high degree of correlation. Flood volumes were related to drainage area, maximum relief and basin slope. Flood peaks were related to drainage area, maximum relief, basin slope, and channel slope. Recurrence intervals considered were 2, 5, 10, 25, 50 and 100 years.

A dimensionless hydrograph was developed to define the characteristic shape of flood hydrographs to be expected from small drainage basins in Wyoming. The method requires a peak discharge in cubic feet per second and a volume in acre-feet to produce a synthetic hydrograph. Some selectivity was used in the development to avoid multipeak events or unusually shaped hydrographs.

An investigation of storage behind a highway embankment with a culvert to allow outflow, has shown that the single fast-rising peak is most important in culvert design. Single peaks cause higher water elevations behind embankments than do multipeak events of the same magnitude and volume. The study was limited to simple box culverts with inlet control.

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GROUND-WATER RESOURCES OF NATRONA COUNTRY, WYOMING
CRIST, M. A.; LOWRY, M. E.
GEOLOGICAL SURVEY, WASHINGTON, D.C. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1897, 1972. 92 P, 21 FIG, 3 PLATE, 4 TAB, 44 REF.,
Journal Announcement: SWRA0517

THE GENERAL OCCURRENCE, CHEMICAL QUALITY, AND AVAILABILITY OF GROUNDWATER IN NATRONA COUNTY, WYOMING, ARE DESCRIBED. SPECIAL ATTENTION IS GIVEN TO IDENTIFYING THE CHEMICAL SUITABILITY OF GROUNDWATER FOR DOMESTIC, LIVESTOCK, INDUSTRIAL, MUNICIPAL, AND IRRIGATION USE. MORE THAN 30 GEOLOGIC FORMATIONS ARE EXPOSED IN THE COUNTY, 28 OF WHICH ARE KNOWN TO YIELD WATER TO WELLS AND SPRINGS. THE MADISON LIMESTONE OF MISSISSIPPIAN AGE AND THE TENSLEEP SANDSTONE AND THE CASPER FORMATION OF PENNSYLVANIAN AND PERMIAN AGE SUPPLY THE LARGEST YIELDS TO WELLS AND SPRINGS. IN THE NORTHEASTERN PART OF THE COUNTY, FLOW FROM EACH OF THREE WELLS IN THE MADISON IS MORE THAN 4,000 GPM. EACH OF THREE WELLS IN THE TENSLEEP IN THE SAME AREA FLOWS MORE THAN 400 GPM.

YIELDS OF SPRINGS IN THE CASPER FORMATION NEAR CASPER MOUNTAIN RANGE FROM ABOUT 1.0 TO 17 CUBIC FEET PER SECOND. GROUNDWATER FROM NEAR THE OUTCROP OF ALL THESE FORMATIONS USUALLY CONTAINS LESS THAN 500 SEVERAL TYPES OF WATER WERE FOUND IN THIS UNIT INCLUDING SODIUM SULFATE, CALCIUM SODIUM SULFATE, CALCIUM SULFATE, SODIUM CALCIUM SULFATE, SODIUM CHLORIDE, AND CALCIUM BICARBONATE. (WOODARD-USGS)

Hydrology of Stock-Water Reservoirs in Upper Cheyenne River Basin
Culler, R. C.
Geological Survey, Cheyenne, Wyo. Water-Supply Paper 1531

The objective of this investigation was to determine the effect on runoff of the many stock reservoirs in the Cheyenne River basin above Angostura Dam. As a first step it was necessary to determine, within reasonable limits of accuracy, the number of reservoirs in the basin, the storage capacity, the drainage area, and the water loss from each. A sampling method was adopted because the size of the basin, 9,100 square miles, prohibited examination of all reservoirs within the drainage area. Forty-nine sample areas of 9 square miles each were selected as a 5-percent sample of the 955 complete quarter townships within the basin above Angostura Dam. All reservoirs located within the sample quarter townships were surveyed.

The 49 sample areas contain 466 operating reservoirs with an aggregate storage capacity of 2,618 acre-feet and an aggregate drainage area of 222 square miles. Applying the findings of the sampling to the area as a whole, it was estimated that the basin contained 9,320 reservoirs with an aggregate storage capacity of 52,360 acre-feet and an aggregate drainage area of 4,440 square miles. In addition there are 16 reservoirs in the basin having capacities in excess of 230 acre-feet. The aggregate total capacity of these reservoirs is 8,035 acre-feet.

A network of observation reservoirs was operated during the four runoff seasons from 1951 to 1954. The number of reservoirs observed ranged from 48 to 57 and produced a total of 212 station-years of record. A complete record for each observation reservoir is included in this report.

An analysis of the observation-reservoir records permitted the computation of volume of annual inflow to reservoirs in all parts of the basin, volume of inflow retained by reservoirs, and volume of retained inflow depleted by evaporation and seepage. Complete computations were made of one each of the two types of runoff producing storms, typical of the Cheyenne River basin.

Water retained by reservoirs is subjected to two major types of depletion-evaporation and seepage. Water evaporated from the water surface constitutes a complete loss chargeable against the reservoirs; but, because seepage may contribute in some degree to ground-water recharge, reservoir loss from this source may in part be recovered. The collected data permitted a fairly comprehensive analysis of the variations of runoff and storage within the basin. Based on this analysis, estimates of losses chargeable to the reservoirs range from 19,000 acre-feet in a dry year to a maximum of 80,000 acre-feet in a very wet year. Discharge from the basin ranges from 50,000 to 180,000 acre-feet.

Geology and mineral resources of the Laramie Basin, Wyoming
Darton, N. H., and Siebenthal, C. E., 1909
U.S. Geological Survey Bulletin 364, 81 p.

Water demands for expanding energy development
Davis, G. H., and Wood, L. A., 1974
U.S. Geological Survey Circular 703, 14 p.

Predicting effects of coal development on surface-water salinity, Green River Basin, Wyoming
DeLong, L. L., 1978
Abstract, Annual Meeting AGU, San Francisco December 4-8, 1978

An Analysis of Salinity in Streams of the Green River Basin, Wyoming
DeLong, L. L.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 728, Price codes: A03 in paper copy, A01 in microfiche. Water-Resources Investigations 77-103, September 1977. 32 p, 18 fig, 4 tab, 6 ref.,
Journal Announcement: SWRA1112
Dissolved-solids concentrations and loads can be estimated for streamflow records using a regression model derived from chemical analyses of monthly samples. The model takes seasonal effects into account by the inclusion of simple-harmonic time functions. Monthly mean dissolved-solids loads simulated for a 6-year period at U.S. Geological Survey water-quality stations in the Green River basin of Wyoming agree closely with corresponding loads estimated from daily specific-conductance records. In a demonstration of uses of the model, an average gain of 114,000 tons of dissolved solids per year was estimated for a 6-year period in a 70-mile reach of the Green River from Fontenelle Reservoir to the town of Green River, including the lower 30-mile reach of the Big Sandy River. (Woodard-USGS)

Predicting effects of coal development on surface-water salinity, Green River Basin, Wyoming
DeLong, L. L., 1979
University of Wyoming; Wyoming Mining Hydrology Seminar, Laramie Wyoming, April 19-20, 1979

Middle and upper Tertiary rocks of southeastern Wyoming and adjoining areas, in, short Papers in the geologic and hydrologic sciences, Article 209
Denson, N. M., and Bergendahl, M. H., 1961
U.S. Geological Survey Professional Paper 424-C, p. C168.

Map of the Wyodak-Anderson coal bed in the Gillette area, Campbell County, Wyoming
Denson, N. M., and Keefer, W. R., 1974
U.S. Geological Survey Miscellaneous Investigations Map I-848-D.

Coal resources of the Gillette area, Wyoming
Denson, N. M., Keefer, W. R., and Horn, G. H., 1973
U.S. Geological Survey Miscellaneous Investigations MapI-848-C.

Geology and coal and oil resources of the Hanna and Carbon Basins, Carbon County, Wyoming
Dobbin, C. E., Bowen, C. F., and Hoots, H. W., 1929a
U.S. Geological Survey Bulletin 804, 88 p.

Geology of the Rock Creek oil field and adjacent areas, Carbon and Albany Counties, Wyoming
Dobbin, C. E., Hoots, H. W., Dane, C. H., and Hancock, E. T., 1929b
U.S. Geological Survey Bulletin 806-D, p. 131-153.

Verification of Step-backwater Computations on Ephemeral Streams in Northeastern Wyoming.
Druse, Stanley A.
Geological Survey, Wyoming, 1979, Water Supply Paper 2199, 29 P, 13 Illus. 1 Ref.
Step-backwater computations were verified by subsequent discharge measurements at three ephemeral streamflow stations in northeastern Wyoming. The standard step-backwater method for gradually varied, subcritical flow was used in computing the water-surface profiles and stage-discharge ratings. Step-backwater computations were made at selected intervals from 1 through 1,000 cubic feet per second on Lodgepole Creek, through 150 cubic feet per second on Raven Creek, and through 600 cubic feet per second on Sand Creek. Stage-discharge rating curves and discharge measurements are illustrated for the three sites, with

lines of 15-percent departure from the rating curves drawn to measure accuracy of the results. All discharge measurements showed departures of less than 15 percent at the high end of the rating curves.

Base Flow and Chemical Quality of Streams in the Northern Great Plains Area, Montana and Wyoming, 1977-78.
Druse, Stanley A., Dodge, Kent A., and Hotchkiss, W. R.
Geological Survey WRI-81-692.

Base-flow discharge and chemical-quality measurements were made at 233 selected sites on streams during October-November 1977, August-September 1978, and October 1978 to provide data on the interaction between surface-water and ground-water systems in the northern Great Plains area of Montana and Wyoming. The tabulated data provide an areally broad data base of con-current base-flow conditions.

Streamflow gains or losses were computed for stream reaches not significantly affected by irrigation. On October 17, 1978, the change in flow of the upper Powder River between Sussex and Arvada, Wyoming, was a loss of 14 cubic feet per second. On the same date, the change in flow of the lower Powder River between Arvada, Wyoming, and Moorhead, Montana, was a gain of 6 cubic feet per second. Except for August- September 1978, major subbasins showed little significant differences in water discharge, chemical character, or dissolved-solids concentrations.

Effects of Coal Mine Subsidence in the Sheridan, Wyoming, Area
Dunrud, C. Richard, and Osterwald, Frank W.
U.S. Geological Survey Professional Paper 1164.

Analyses of the surface effects of past underground coal mining in the Sheridan, Wyoming, area suggest that underground mining of strippable coal deposits may damage the environment more over long periods of time than would modern surface mining, provided proper restoration procedures are followed after surface mining. Subsidence depressions and pits are a continuing hazard to the environment and to man's activities in the Sheridan, Wyo., area above abandoned underground mines in weak overburden less than about 60 m thick and where the overburden is less than about 10-15 times the thickness of coal mined. In addition, fires commonly start by spontaneous ignition when water and air enter the abandoned mine workings via subsidence cracks and pits. The fires can then spread to unmined coal as they create more cavities, more subsidence, and more cracks and pits through which air can circulate.

In modern surface mining operations the total land surface underlain by minable coal is removed to expose the coal. The coal is removed, the overburden and topsoil are replaced, and the land is regraded and revegetated. The land, although disturbed, can be more easily restored and put back into use than can land underlain by abandoned underground mine workings in areas where the overburden is less than about 60 m thick or less than about 10-15 times the thickness of coal mined. The resource recovery of modern surface mining commonly is much greater than that of underground mining procedures. Although present-day underground mining technology is advanced as compared to that of 25-80 years ago, subsidence resulting from underground mining of thick coal beds beneath overburden less than about 60 m thick can still cause greater damage to surface drainage, ground water, and vegetation than can properly designed surface mining operations. This report discusses (1) the geology and surface and underground effects of former large-scale underground coal mining in a 50-square kilometers area 5-20 km north of Sheridan, Wyo., (2) a ground and aerial reconnaissance study of a 5-square kilometers coal mining area 8-10 km west of Sheridan, and (3) some environmental consequences and problems caused by coal mining.

The Biology of Salt Wells Creek and Its Tributaries, Southwestern Wyoming

Engelke, M. J. Jr

Geological Survey, Cheyenne, WY. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-300828, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-121, 1978. 82 p, 43 Fig, 15 Tab, 22 Ref.,

Journal Announcement: SWRA1306

A description of aquatic organisms and biological communities is presented for Salt Wells Creek, a plains stream in the Green River basin. The description includes seasonal population fluctuations of benthic organisms and algae, the food pyramid, and nutrient relations between various types of plants and animals. The algae and stream invertebrates were studied to determine baseline data and biological indicators of water quality. (Woodard-USGS).

Geochemistry of groundwaters in the Powder River coal region, *in* U.S. Geological Survey, 1977, Geochemical Survey of the western energy regions, fourth annual progress report. (Duplicated see Montana).

Feder, G. L., Lee, R. W., Busby, J. F., and Saindon, L. G., 1977

U.S. Geological Survey Open-File Report 77-872, p. 173-179.

Restored stratigraphic cross sections and coal correlations in the Tongue River Member of the Fort Union Formation, Powder River area, Wyoming

Flores, R. M., and Canavello, D. A., 1979

U.S. Geological Survey Miscellaneous Field Studies Map MF-1126, 2 sheets.

Water-Quality Data for the Hanna and Carbon Basins, Wyoming
Freudenthal, P. B.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from: OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225, paper copy $6.00, microfiche $3.50. Geological Survey open-file report 79-1277, August 1979. 41 p, 4 Fig, 7 Tab, 10 Ref.,
Journal Announcement: SWRA1314

Water-quality data for the Hanna and Carbon Basins, south-central Wyoming, are presented in tables with no interpretation. Common-constituent, trace-element, and radiochemical data for ground and surface water and sediment concentrations for surface water are included. Ground water at 53 sites and surface water at 3 gaging stations were sampled. (Kosco-USGS)

Methodology for Hydrologic Evaluation of a Potential Surface Mine: The Red Rim Site, Carbon and Sweetwater Counties, Wyoming.
Frickel, D. G., Shown, L. M., Hadley, R. F., and Miller, R. F.
U.S. Geological Survey WRI 81-75.

Permit applications made to the Office of Surface Mining for mining of near-surface coal deposits contain both mining and reclamation plans. These plans must be evaluated by regulatory authorities for compliance with the permanent regulations of the Surface Mining Control and Reclamation Act of 1977. Methodologies are presented for assessing the effects of mining and reclamation on the hydrologic system of a potential permit area and the adjacent area, together comprising about 1.6 square miles, in the drainage basin of Separation Creek, Carbon and Sweetwater Counties, Wyoming. The study area is representative of the hydrologic problems that exist in a semiarid environment of the high plains in Wyoming.

The premining hydrology and geology of the study area are described primarily as a basis for evaluation of potential changes that may occur. Data for soil-moisture relations in seven soil-vegetation types show that differences in void space and particle surface-area available for water storage are important factors in planning reclamation. Estimates are also made of runoff volumes and peak discharges for flow magnitudes of specified recurrence intervals using a regression model developed for the State of Wyoming. A shallow aquifer and its hydraulic characteristics are described in the study area. Methods for estimating erosion and sediment yield in the study area by means of the Universal Soil Loss Equation (USLE) and reservoir sedimentation surveys are described.

Selected Hydrologic Data, Yampa River Basin and Parts of the White River Basin, Northwestern Colorado and South-Central

Wyoming. (Duplicated see Colorado).
Giles, T. F.; Brcgden, R. E.
Geological Survey, Denver, CO. Water Resources Div.
Available from the OFSS Branch of Distribution, USGS, Box 25425 Fed. Ctr. Denver, Colo. 80225. Open-file report 78-23, January 1978. 91 p, 1 fig, 2 plates, 5 tab, 7 ref.,
Journal Announcement: SWRA1120

Stratigraphy and nomenclature of some upper Cretaceous and lower Tertiary rocks in south-central Wyoming
Gill, J. R., Merewether, E. A., and Cobban, W. A., 1970
U.S. Geological Survey Professional Paper 667, 53 p.

A Plan for Hydrologic Investigations of In Situ, Oil-Shale Retorting near Rock Springs, Wyoming.
Glover, Kent C., Zimmerman, Everett A., Larson, L. R., and Wallace, Joe C.
U.S. Geological Survey Open-File Report 82-758.
The recovery of shale oil by the in situ retort process may cause hydrologic impacts, the most significant being ground-water contamination and possible transport of contaminants into unaffected areas. Although these impacts are site-specific, many of the techniques used to investigate each retort operation commonly will be the same. The U.S. Geological Survey has begun a study of hydrologic impacts in the area of an in situ retort near Rock Springs, Wyoming, as a means of refining and demonstrating these techniques. Geologic investigations include determining the areal extent and thickness of aquifers. Emphasis will be placed on determining lithologic variations from geophysical logging. Hydrologic investigations include mapping of potentiometric surfaces, determining rates of ground-water discharge, and estimating aquifer properties by analytical techniques. Water-quality investigations include monitoring solute migration from the retort site and evaluating sampling techniques by standard statistical procedures. A ground-water-flow and solute-transport model will be developed to predict future movement of the solute plume away from the retort.

Ground-Water Sub-Group, Water Work Group, Northern Great Plains Resources Program, 1974, Shallow ground-water in selected areas in the Fort Union coal region. (Duplicated see Montana).
U.S. Geological Survey Open-File Report 74-371, 132 p.

Map showing some potential effects of surface mining of the Wyodak- Anderson Coal, Gillette area, Campbell Co., Wyo.
Hadley, R. F., and Keefer, W. R., 1975
U.S. Geological Survey Miscellaneous Investigations Series, Map

I-848F, scale 1:24,000, 1 sheet.

This map report describes some of the potential effects on ground-water levels and indicates the extent of land disturbance that may occur as a result of surface mine development. The data that the report is based on was collected in the Gillette, Wyoming area underlain by the Wyodak-Anderson coal bed.

Hydrologic Effects of Water Spreading in Box Creek Basin, Wyoming.

Hadley, R. F., McQueen, I. S., and others.

U.S. Geological Survey Water Supply Paper 1532-A.

A study was made during the summer seasons of 1956 and 1957 to determine the use of water by a water-spreading system in Box Creek basin, Converse County, Wyo., which was designed to reduce sediment yield and fluvial erosion. The water-spreading system on Box Creek consists of 27 small dams that divert the flow directly onto the flood plain, where it is used to irrigate a hay meadow of 360 acres.

Two gaging stations were established, one above the water-spreading system and one below, to measure inflow, outflow, and suspended sediment. Also, a network of precipitation gages, ground-water observation wells, and observations on soil-moisture were an integral part of the hydrologic investigation.

There were six runoff events during the 1956 and 1957 seasons for which inflow and outflow through the water-spreading system could be determined. The total inflow for the six runoff periods was 2,026 acre-feet and the outflow was 1,330 acre-feet, which represents a loss of 34 percent of surface flow entering the water spreader.

Total reduction in suspended-sediment load for the six runoff periods was not determined because of the many ungaged tributaries between gaging stations. However, two of the storms originated above the upper gaging station and the suspended-sediment load in the inflow was 4,513 tons and the outflow was 1,119 tons, which represents a decrease of 75 percent between stations. During the 2 years of observation, the total sediment deposition on the water-spreading system was 17.8 acre-feet or 0.049 acre-foot per acre. Most of this sediment was derived from slopes adjacent to the water spreader and, therefore, introduced some uncertainties in evaluating the sediment-retention efficiency of this type of land treatment.

Data from ground-water observation wells show that some of the surface flow entering the water-spreading system at the upper end may penetrate to a perched water table.

Preliminary applications of Landsat images and aerial photography for determining land-use, geologic, and hydrologic characteristics--Yampa River basin, Colorado and Wyoming.

Heimes, F. J., Moore, G. K., and Steele, T. D., 1978
U.S. Geological Survey, Water-Resources Investigation Report 78-96.

Logs of wells in Campbell County, Wyoming.
Hodson, Warren G.
U.S. Geological Survey Open-File Report (unnumbered), 210 P., 1 Table.

The report contains approximately 1,200 logs of water wells in Campbell County, Wyoming. The logs are unedited and are given in the style and wording of the driller. Depth to water, yield and drawdown, and use of water are given, if known.

Records of Water Wells...Test Holes, and Chemical Analyses of Water for the Madison Limestone...Powder River Basin...Wyoming.
Hodson, Warren G.
U.S. Geological Survey.
Publication of the Wyoming State Engineer and Wyoming Department of Economic Planning and Development Prepared by the U.S. Geological Survey. 29 P., 13 Illus. 1 Ref.

The report contains data on the Madison Limestone (or equivalent rocks) for the Powder River Basin and adjacent areas in northeastern Wyoming. Records of 56 water wells and springs developed in the Madison, 222 water wells and oil and gas test holes that reached the Madison, and 71 chemical analyses of Madison waters are tabulated in three tables. Location sites for data collected are shown on a map of the area.

CHEMICAL ANALYSES OF GROUND WATER IN THE POWDER RIVER BASIN AND ADJACENT AREAS, NORTHEASTERN WYOMING
HODSON, W. G.
GEOLOGICAL SURVEY, CHEYENNE, WYO. WATER RESOURCES DIV.
WYOMING DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT BASIC-DATA REPORT, 1971. 20 P, 1 FIG, 2 TAB, 9 REF.,
Journal Announcement: SWRA0508

A TABLE OF CHEMICAL ANALYSES CONTAINS THE RESULTS OF 490 ANALYSES OF WATER FROM WELLS AND SPRINGS FROM THE POWDER RIVER BASIN AND ADJACENT AREAS IN NORTHEASTERN WYOMING. THE ANALYSES ARE TABULATED BY COUNTY, AQUIFER, AND WELL NUMBER. THE QUALITY OF A WATER IS JUDGED ACCORDING TO THE USE FOR WHICH IT IS NEEDED. GENERALLY, THE LOWER THE DISSOLVED SOLIDS, THE BETTER THE WATER. FOR SOME USES, HOWEVER, THE CONCENTRATION OF PARTICULAR CONSTITUENTS IN A WATER MAY BE MORE IMPORTANT THAN THE TOTAL CONCENTRATION OF DISSOLVED SOLIDS. THE PRINCIPAL CONSTITUENTS ANALYZED, THEIR CHARACTERISTICS, AND

RECOMMENDED MAXIMUM CONCENTRATIONS FOR DOMESTIC AND MUNICIPAL USE ARE GIVEN. THE DISSOLVED SOLIDS RANGED FROM 58 TO 30,000

WATER RESOURCES OF THE POWDER RIVER BASIN AND ADJACENT AREAS, NORTHEASTERN WYOMING
HODSON, W. G.; PEARL, R. H.; DRUSE, S. A.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
HYDROLOGIC INVESTIGATIONS ATLAS HA-465, 1973. 4 SHEETS, 9 FIG, 11 TAB, 4 MAPS, 70 REF.,
Journal Announcement: SWRA0723

GENERAL INFORMATION IS GIVEN CONCERNING THE AVAILABILITY AND QUALITY OF GROUNDWATER RESOURCES OF THE POWDER RIVER BASIN, WYOMING, IN A 4-SHEET HYDROLOGICAL ATLAS. THE POWDER RIVER BASIN IS A STRUCTURAL AND TOPOGRAPHIC BASIN BOUNDED ON THE WEST BY THE BIGHORN MOUNTAINS, ON THE SOUTHWEST BY THE CASPER ARCH, ON THE EAST BY THE BLACK HILLS, AND ON THE SOUTH BY THE LARAMIE RANGE AND HARTVILLE UPLIFT. MEAN ANNUAL PRECIPITATION DECREASES BASINWARD FROM 16.32 INCHES AT SUNDANCE AND 15.91 INCHES AT SHERIDAN TO 14.00 INCHES AT GILLETTE AND 11.80 INCHES AT CASPER. POTENTIAL EVAPORATION IS HIGH, ESPECIALLY IN THE POWDER RIVER BASIN, AND IS SEVERAL TIMES THE PRECIPITATION; CONSEQUENTLY, MUCH SNOW, SURFACE WATER, AND SOIL MOISTURE EVAPORATE TO THE ATMOSPHERE. ALLUVIUM ALONG IRRIGATED VALLEYS IS RECHARGED IN PART FROM IRRIGATION WATER. SOME MOVEMENT OF WATER BETWEEN FORMATIONS PROBABLY OCCURS IN THE SUBSURFACE. DISCHARGE IS MAINLY BY EVAPORATION, SEEPAGE TO SPRINGS AND LAKES, TRANSPIRATION BY PLANTS, AND PUMPAGE FROM WELLS. MOST GROUNDWATER DEVELOPMENT HAS BEEN FOR STOCK AND DOMESTIC PURPOSES, AND WELLS ARE USUALLY DRILLED AND DEVELOPED TO SUPPLY WATER SUFFICIENT FOR THESE NEEDS ONLY. THE QUALITY OF GROUNDWATER RANGES FROM GOOD TO HIGHLY MINERALIZED. DISSOLVED SOLIDS CAN BE EXPECTED TO BE LESS AGE AND FROM INTRUSIVE IGNEOUS ROCKS OF TERTIARY AGE. THE AVERAGE RATE OF DISCHARGE PER SQUARE MILE IS SHOWN ON A MAP FOR EACH STATION. THE YIELDS FROM THE NONMOUNTAINOUS DRAINAGE BASINS (BELLE FOURCHE RIVER, CHEYENNE RIVER, AND THE SOUTHERN AND EASTERN PARTS OF THE POWDER RIVER BASIN) GENERALLY ARE LESS THAN 0.05 CFSM (CUBIC FEET PER SECOND PER SQUARE MILE), AND FROM THE MOUNTAIN STATIONS GENERALLY ARE MORE THAN 0.3 CFSM. DISCHARGE FROM STREAMS IN THE NONMOUNTAINOUS AREAS IS GREATLY AFFECTED BY STORAGE IN STOCKWATER RESERVOIRS AND BY THE VARIABLE PATTERN OF THUNDERSTORM ACTIVITY OVER THE AREA. (KNAPP-USGS)

A Guide to State Programs for the Reclamation of Surface Mined Areas.
Imhoff, Edgar A., Friz, Thomas O., and LaFevers, James R.
U.S. Geological Survey Circular 731.

During 1975 inquiries of agencies in each State and review of State statutes and related administrative codes revealed that 38 States have established programs requiring the reclamation of surface mined lands. Results of analyses of those programs and ancillary data are presented in: (1) A table (matrix) which has been designed for the notation and elaboration of information pertaining to the mined-area reclamation programs of the 50 States; (2) a primer on surface mining activities and related reclamation practices and problems; and (3) a listing of types of non-Federal governmental controls applicable to reclamation. Interpretations of the status and content of State programs suggest that although a common thread runs through State statutory language, administrative requirements vary from State to State in order to meet different natural economic, social, and political considerations. A general trend is seen in State programs toward the requiring of an integration of land-use planning and mine planning, with increased local governmental involvement.

Geology and ground-water resources of the Kaycee irrigation project, Johnson County, Wyoming with a section on Chemical quality of the ground water by F. H. Rainwater
Kahout, F. A., 1957
U.S. Geological Survey Water-Supply Paper 1360-E.

Land and natural resource information and some potential environmental effects of surface mining of coal in the Gillette area, Wyoming
Keefer, W. R., and Hadley, R. F., 1976
U.S. Geological Survey Circular 743, 27 p.
Campbell County, along the east margin of the Powder River Basin in northeastern Wyoming, contains more coal than any other county in the United States. The principal deposit is the Wyodak-Anderson coal bed. The bed is 50-100 feet (15-30 meters) thick over large areas, lies less than 200 feet (60 meters) deep in a north-south trending strip nearly 100 miles (161 kilometers) long and 2-3 miles (3-5 kilometers) wide, and contains an estimated 15 billion tons (13.6 billion metric tons) of subbituminous, low-sulfur coal that is presently considered to be accessible to surface mining. Extensive mining of this deposit has the potential for causing a variety of environmental impacts and has been a matter of much public concern and debate in recent years.
An integrated program of geologic, hydrologic, geochemical, and related studies by the U.S. Geological Survey in central Campbell County provides basic information about the land and its resources, including (1) characteristics of the landscape, (2) properties of rocks and surface materials, (3) depth and thickness of coal, (4) streamflow, (5) depth to ground water, (6) quality of ground water, (7) sediment yield, (8) concentrations of trace elements in soils, rocks, coal, vegetation, and water, and (9) current land use. The data are used to analyze and predict some of the potential environmental effects of surface mining, such as the extent of land disturbance, nature and degree

of landscape modigication, and disruption of surface-water and ground-water systems. Advance knowledge and understanding of these and other problems are useful in the planning and regulation of future leasing, mining, reclamation, and related activities.

Energy resources map of the Powder River basin, Wyoming and Montana (Duplicated see Montana).
Keefer, W. R., and Schmidt, P. W., 1973
U.S. Geological Survey Miscellaneous Investigations Map I-847-A.

Sediment Transport and Source Areas of Sediment and Runoff, Big Sandy River Basin, Wyoming.
Kircher, James E.
U.S. Geological Survey Water-Resources Investigation Report 81-72. 57 P.
A study was conducted for the resolution of sediment source areas in the Big Sandy River basin, southwestern Wyoming. Suspended-sediment and bedload data were collected in order to determine total sediment transport at several locations within the basin.
The bedload data were compared to the Einstein bedload function and total load data were compared to the Colby method. The bedload comparison showed a higher estimation of transport rates with Helley-Smith sampler measurements than with the Einstein bedload function. The Colby method yielded higher transport rates at high flows and lower transport rates at low flows than the measured total transport rate.
The Big Sandy Reservoir acts as a control in the basin. The area upstream of the reservoir was interpreted separately from the area downstream for source-area determination. In the arid plains upstream of the reservoir, the amount of sediment transported increased 98 percent with an increase in runoff of only 1 percent.

Water Resources of Upper Separation Creek Basin, South-Central Wyoming
Larson, L. R.; Zimmerman, E. A.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-224263, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-85, April, 1981. 69 p, 31 Fig, 10 Tab, 17 Ref.,

Journal Announcement: SWRA1420

Expected development of coal in the 85-square-mile upper Separation Creek basin of south-central Wyoming will greatly increase the demands on water resources. Flows in Separation Creek are seasonal and highly variable. Streamflow is primarily caused by snowmelt. Very light snowpack in the spring of 1977 resulted in annual runoff being only 10 percent of that for the previous year. Surface-water quality is variable in both time and space. Dissolved-solids concentrations ranged from less than 100 to more than 1,500 milligrams per liter. Flushing of accumulated salts occurs during a rising stage. Ground water is obtainable from the Mesaverde Formation, the Lance and Fort Union Formations, and from alluvium. Yields from wells and springs are usually less than 10 gallons per minute, though some springs flow as much as 35 gallons per minute. Ground-water quality varies with the formation. Stream biota are governed by the intermittent nature of the stream and by habitat. Daily mean sediment concentrations ranged from 34 to 11,900 milligrams per liter. (USGS)

WATER RESOURCES OF THE THRUST BELT OF WESTERN WYOMING
LINES, G. C.; GLASS, W. R.
GEOLOGICAL SURVEY, CHEYENNE, WYO.
FOR SALE BY USGS, RESTON, VA. 22092; PRICE $2.00 PER SET. HYDROLOGIC INVESTIGATIONS ATLAS HA-539, 1975. 3 SHEETS, 38 REF.,
Journal Announcement: SWRA0913

THIS ATLAS REPORT DESCRIBES THE RESULTS OF ONE OF A SERIES OF WATER-RESOURCES RECONNAISSANCE STUDIES OF LARGE AREAS IN WYOMING BY THE U.S. GEOLOGICAL SURVEY IN COOPERATION WITH THE WYOMING STATE ENGINEER. THE PURPOSES OF THE STUDY ARE TO OBTAIN A GENERAL KNOWLEDGE OF THE OCCURRENCE, AVAILABILITY, AND QUALITY OF GROUNDWATER AND TO SUMMARIZE FLOW CHARACTERISTICS AND CHEMICAL QUALITY OF WATER IN MAJOR STREAMS IN THE THRUST BELT OF WESTERN WYOMING. THE THRUST BELT IS AN ELONGATE, NEARLY RECTANGULAR AREA OF ABOUT 5,300 SQ MI IN THE MIDDLE ROCKY MOUNTAIN PHYSIOGRAPHIC PROVINCE. THE LARGEST USE OF WATER IN THE AREA IS FOR IRRIGATION OF ALFALFA, GRASS HAY, AND PASTURE TO COMPLEMENT LIVESTOCK GRAZING ON THE VASTLY LARGER AREAS OF FOREST AND RANGE LAND. IN THAT PART OF THE BEAR RIVER BASIN THAT IS IN WYOMING, AN ESTIMATED 58,700 ACRES WERE IRRIGATED IN 1970 (HUNTER AND OTHERS, 1971); ONLY ABOUT 2,000 ACRES OF THIS TOTAL WAS IRRIGATED WITH WATER FROM WELLS. INDUSTRIAL WATER USE IN 1970 IS ESTIMATED AT 6 MGD WITH ABOUT 80 PERCENT OF THE WATER DERIVED FROM SURFACE-WATER SOURCES. APPROXIMATELY TWO-THIRDS OF THE ESTIMATED 18,000 PEOPLE THAT LIVED IN THE STUDY AREA IN 1970 WERE SERVED BY MUNICIPAL WATER SUPPLIES IN AFTON, COKEVILLE, EVANSTON, KEMMERER, JACKSON, AND THAYNE. ESTIMATED USE IN 1970 BY THESE MUNICIPAL SUPPLIES WAS 5.4 MGD. THREE AREAS OF THERMAL-WATER DISCHARGE ARE KNOWN IN THE AREA. (WOODARD-USGS)

Reconnaissance of the geology and ground-water hydrology of the Laramie Basin, Wyoming
Littleton, R. T., 1950
U.S. Geological Survey Circular 180, 37 p.

Preliminary potentiometric-surface map showing freshwater heads for the lower Cretaceous rocks in the Northern Great Plains of Montana, North Dakota, South Dakota, and Wyoming
Lobmeyer, D. H., 1980
U.S. Geological Survey Open-File Report 80-757.

A PLAN FOR STUDY OF WATER AND ITS RELATION TO ECONOMIC DEVELOPMENT IN THE GREEN RIVER AND GREAT DIVIDE BASINS IN WYOMING
LOWHAM, H. W.; DE LONG, L. L.; PETER, K. D.; AL, ET
GEOLOGICAL SURVEY, CHEYENNE, WYO.
OPEN-FILE REPORT 76-349, MAY 1976. 92 P, 37 FIG, 11 TAB, 73 REF.,
Journal Announcement: SWRA0924

DEVELOPMENT OF EXTENSIVE COAL, OIL, GAS, TRONA, AND OIL-SHALE RESOURCES AS WELL AS OTHER DEVELOPMENTS IN THE GREEN RIVER AND GREAT DIVIDE BASINS IN WYOMING WILL REQUIRE A PROJECTED INCREASE IN WATER CONSUMPTION OF 490,000 ACRE-FT PER YEAR BY 2020. DEVELOPMENTS OF ENERGY RESOURCES IN OTHER PARTS OF WYOMING WILL ALSO REQUIRE LARGE AMOUNTS OF WATER; TRANSBASIN DIVERSION OF GREEN RIVER WATER TO OTHER AREAS COULD TOTAL AN ADDITIONAL 270,000 ACRE-FT PER YEAR. IN ANTICIPATION OF THIS INCREASED DEMAND, WATER PLANNERS AND MANAGERS NEED MUCH MORE INFORMATION ABOUT AVAILABLE GROUND AND SURFACE WATERS, PRESENT QUALITY OF THE WATERS, AND HYDROLOGIC EFFECTS THAT WOULD BE CAUSED BY DEVELOPMENT OF ENERGY RESOURCES. THE U.S. GEOLOGICAL SURVEY IS CONDUCTING AN EXTENSIVE HYDROLOGIC STUDY OF THE BASINS. THIS REPORT SUMMARIZES THE STUDY PLAN AND DISCUSSES PARTICULAR METHODS OF APPROACH THAT WOULD BE UTILIZED IN THE STUDY. REGARDING WATER QUALITY, PARTICULAR ATTENTION IS BEING GIVEN TO TRACE METALS, BIOLOGICAL CHARACTERISTICS, AND TREND ANALYSES OF SALINITY. CHANNEL-GEOMETRY TECHNIQUES, DETAILED STATISTICAL ANALYSES, AND MATHEMATICAL MODELS ARE BEING APPLIED TO SURFACE-WATER STUDIES. AN UPDATED WELL INVENTORY, AQUIFER TESTS, AND BOREHOLE AND SURFACE GEOPHYSICAL SURVEYS ARE BEING USED IN GROUND-WATER STUDIES. (WOODARD-USGS)

An analysis of stream temperatures, Green River Basin, Wyoming
Lowham, H. W., 1978
U.S. Geological Survey Water-Resources Investigations 78-13. 50 P., 14 Illus., 5 Tables, 25 Ref.

This report presents a method for estimating temperatures of streams in the Green River Basin, Wyoming. The procedure utilizes a regional model for estimating mean daily temperatures of streams at unmeasured sites. The regional model was developed by describing annual temperature patterns at 43 measured sites in the basin and by applying the harmonic function $T = M + A [\sin (0.0.72 t + C)]$ where: T is mean daily temperature; M, A, and C are harmonic coefficients calculated from data for each stream-temperature station; and t is the day of the water year.

Application of the above equation for estimating temperatures at unmeasured sites requires regionalized estimates of M, A, and C. Regional estimates were developed with the aid of multiple-regression techniques, whereby the calculated harmonic coefficients were regressed against physical and climatic characteristics of the stream-temperature stations. Stream elevation was found to be a significant factor affecting water temperature.

Analysis of areal and temporal variations in temperature showed that springs, irrigation return flows, and reservoir storage were affecting reaches of several major streams.

Streamflows and Channels of the Green River Basin, Wyoming
Lowham, H. W.
U.S. Geological Survey Water Resources Investigation Report 81-71, 81 P.

Width, Depth, cross-sectional area, and velocity of streamflow were depicted for 51 gaged sites by summarizing data obtained from current-meter discharge measurements. Using these at-a-station relations as a base, regional relations were then developed that characterize hydraulic features of streams throughout the study area.

Channel size is an indication of flow magnitude. High flows influence channel formation, and the annual peak-flow array is a representation of these flows. The geometric mean of this array is a viable statistical index of channel-forming flows because it represents the relative magnitude of high flows at a site. Bankfull discharge is a physical index of flows dominating channel formation. The magnitude of the geometric mean equates closely to bankfull discharge, on the average. Relations depicting hydraulic characteristics to a discharge equal to the geometric mean of annual peak flows may therefore be considered to be generally representative of channel conditions existing during bankfull discharge. The relations have application for predicting channel response to developments that would alter streamflow.

Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming
Lowham, H. W.; Delong, L. L.; Collier, K. R.; Zimmerman, E. A.
Geological Survey, Cheyenne, WY. Water Resources Div., and Geological Survey, Tacoma, WA. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-201211, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources

Investigations 81-62, April 1982. 52 p, 32 Fig, 2 Tab, 24 Ref.,
Journal Announcement: SWRA1512

Development of energy minerals in plains areas of Wyoming is expanding rapidly. Such development may affect water resources and hydrologic relations of the plains; however, little information exists concerning hydrologic processes for these areas. This report summarizes results of a hydrologic study made during 1975-78 of Salt Wells creek, a drainage area of about 500 square miles located southeast of Rock Springs, Wyoming. The area is typical of arid and semiarid plains areas in southwestern Wyoming where mineral development is occurring. Salt Wells Creek is predominately an intermittent stream. Numerous springs in the headwaters cause small perennial flows in some upstream tributaries, but evaporation, freezeup, and seepage deplete these flows so that the middle and lower reaches of the main channel have only intermittent flows. The intermittent nature of streamflow affects water quality. It was observed that a flushing of dissolved solids and suspended sediment occurs during the first flows of a runoff event. A striking feature of the stream is its deeply incised channel. The downcutting is attributed to the cummulative effects of: (1) a change in the relative climate, amounts of annual precipitation occurring as rain and snow, (2) change in base level due to downstream channelization, and (3) changes in land use. Because of the incision, erosion is now expanding to include intervening tributaries. (USGS)

CHEMICAL ANALYSES OF GROUNDWATER IN THE BIGHORN BASIN, NORTHWESTERN WYOMING
LOWRY, M. E.; LINES, G. C.
GEOLOGICAL SURVEY, CHEYENNE, WYO. WATER RESOURCES DIV.
WYOMING DEPARTMENT OF ECONOMIC PLANNING AND DEVELOPMENT BASIC-DATA REPORT, 1972. 16 P, 1 FIG, 2 TAB, 9 REF.,
Journal Announcement: SWRA0513

A TABLE OF CHEMICAL ANALYSES OF GROUNDWATER IN THE BIGHORN BASIN IN WYOMING CONTAINS THE RESULTS OF 257 ANALYSES OF WATER FROM WELLS AND SPRINGS. THE ANALYSES ARE TABULATED BY COUNTY, AQUIFER, AND WELL NUMBER. A MAP SHOWS THE LOCATIONS OF WELLS AND SPRINGS SAMPLED. OF THE ANALYSES, 87 ARE FOR GROUNDWATER SAMPLES COLLECTED DURING THE BIGHORN BASIN INVESTIGATION DURING 1969-70. MANY OF THE ANALYSES ARE FROM THE FILES OF THE WATER RESOURCES DIVISION OF THE U.S. GEOLOGICAL SURVEY IN CHEYENNE, WYOMING, AND HAVE BEEN PUBLISHED PREVIOUSLY. THE SODIUM-ADSORPTION RATIO FOR WATERS LISTED IS AN INDEX OF THE SODIUM HAZARD OF THE WATERS AND EXPRESSES THE RELATIVE ACTIVITY OF SODIUM IONS IN EXCHANGE REACTIONS WITH SOIL. INCLUDED IS A TABLE OF MAJOR CONSTITUENTS IN WATER AND THEIR EFFECTS UPON USABILITY. (WOODARD-USGS)

Hydrology of the uppermost Cretaceous and lowermost Paleocene rocks in the Hilight oil field, Campbell County, Wyoming
Lowry, M. E., 1973

U.S. Geological Survey Open-File Report, 60 p.

Ground-water resources of Sheridan County, Wyoming
Lowry, M. E., and Cummings, T. R., 1966
U.S. Geological Survey Water Supply Paper 1807, 77 p.

Sheridan County is in the north-central part of Wyoming and is an area of about 2,500 square miles. The western part of the county is in the Bighorn Mountains, and the eastern part is in the Powder River structural basin. Principal streams are the Powder and Tongue Rivers, which are part of the Yellowstone River system. The climate is semiarid, and the mean annual precipitation at Sheridan is about 16 inches.

Rocks of Precambrian age are exposed in the central part of the Bighorn Mountains, and successively younger rocks are exposed eastward. Rocks of Tertiary age, which are the most widespread, are exposed throughout a large part of the Powder River structural basin. Deposits of Quaternary age underlie the flood plains and terraces along the larger streams, particularly in the western part of the basin.

Aquifers of pre-Tertiary age are exposed in the western part of the county, but they dip steeply and are deeply buried just a few miles east of their outcrop. Aquifers that might yield large supplies of water include the Bighorn Dolomite, Madison Limestone, Amsden Formation, and Tensleep Sandstone. The Flathead Sandstone, Sundance Formation, Morrison Formation, Cloverly Formation, Newcastle Sandstone, Frontier Formation, Parkman Sandstone, Bearpaw Shale, and Lance Formation may yield small or, under favorable conditions, moderate supplies of water.

Few wells tap aquifers of pre-Tertiary age, and these are restricted to the outcrop area. The meager data available indicate that the water from the Lance Formation, Bearpaw Shale, Parkman Sandstone, Tensleep Sandstone and Amsden Formation, and Flathead Standstone is of suitable quality for domestic or stock purposes, and that water from the Tensleep Sandstone and Amsden Formation and the Flathead Sandstone is of good quality for irrigation. Samples could not be obtained from other aquifers of pre-Tertiary age; so the quality of water in these aquifers could not be determined.

Adequate supplies of ground water for stock or domestic use can be developed throughout much of the report area from the Fort Union and Wasatch Formations of Tertiary age; larger supplies might be obtained from the coarse-grained sandstone facies of the Wasatch Formation near Moncreiffe Ridge. Four aquifer tests were made at wells tapping formations of Tertiary age, and the coefficients of permeability determined ranged from 2.5 to 7.9 gallons per day per square foot. The depths to which wells must be drilled to penetrate an aquifer differ within relatively short distances because of the lenticularity of the aquifers. Water in aquifers of Tertiary age may occur under water-table, artesian, or a combination of artesian and gas-lift conditions.

Water from the Fort Union is usable for domestic purposes, but the iron and dissolved-solids content impair the quality at some localities. Water from the Fort Union Formation is not recommended for irrigation because of sodium and bicarbonate content. The water is regarded as good to fair for stock use. Water from the Wasatch Formation generally contains dissolved solids in excess of the suggested domestic standards, but this water is usable in the absence of other supplies. The development of irrigation supplies from the Wasatch Formation may be possible in some areas, but the water quality should be carefully checked. Water of good to very poor quality for stock supplies is obtained, depending upon the location. Hydrogen sulfide, commonly present in water of the Fort Union and Wasatch Formations, becomes an objectionable characteristic when the water is used for human consumption.

Deposits of Quaternary age generally yield small to moderate supplies of water to wells. Two pumping tests were conducted, and the coefficients of permeability of the aquifers tested were 380 and 1100 gallons per day per square foot. Usable supplies of ground water can be developed from the deposits of Quaternary age, principally along the valleys of perennial streams that head in the mountains and from terraces in the western part of the county; the thickest known deposit of alluvium is in the valley of Dutch Creek, which heads in the Powder River structural basin. Water from the alluvium is usable as a stock supply but has objectionable characteristics for domestic and irrigation use.

Recharge to ground-water reservoirs is from precipitation and seepage from streams and irrigation. Recharge conditions are generally better in the western part of the basin, where precipitation is greater and where there are more perennial streams and irrigated lands. Discharge from the ground-water reservoirs is by seepage to streams, evaporation, transpiration, and by wells and springs.

Water Resources of the Bighorn Basin, Northwestern Wyoming
Lowry, M. E.; Lowham, H. W.; Lines, G. C.
Geological Survey, Cheyenne, Wyo. Water Resources Div.
Available from Branch of Distribution, USGS, Box 25286, Federal Ctr., Denver, Colo. 80225, price $3.00. Hydrologic Investigations Atlas HA-512, 1976. 2 sheets, 47 ref.,
Journal Announcement: SWRA1009

This 2-sheet map report includes the part of the Bighorn Basin and adjacent mountains in northwestern Wyoming. Water-bearing properties of the geologic units are summarized. The hydrogeologic map illustrates the distribution of wells in the different units and gives basic data on the yields of wells, depth of wells, depth to water, and dissolved solids and conductance of the water. Aquifers capable of yielding more than 1,000 gpm (gallons per minute) underlie the area everywhere, except in the mountains on the periphery of the basin. In 1970, approximately 29,500 of the 40,475 people living in the Bighorn Basin were served by municipal water supplies. The municipal supply for about 6,300 of these people was from ground water. The natural flows of streams in the Bighorn Basin differ greatly due to a wide range in the meteorologic, topographic, and geologic conditions of the basin. The station locations and the average discharge per square mile are shown on the map and give an indication of the geographic variation of basin yields. The maximum instantaneous discharge that has occurred at each station during its period of record is shown. Most of the runoff in the basin is from snowmelt in the mountains. (Woodard-USGS)

WATER RESOURCES OF THE LARAMIE, SHIRLEY, HANNA BASINS AND ADJACENT AREAS, SOUTHEASTERN WYOMING
LOWRY, M. E.; RUCKER, S. J. IV; WAHL, K. L.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
HYDROLOGIC INVESTIGATIONS ATLAS HA-471, 1973. 4 SHEETS, 14 FIG, 5 TAB, 10 MAPS, 36 REF.,
Journal Announcement: SWRA0722

THE AVAILABILITY AND QUALITY OF GROUNDWATER AND FLOW CHARACTERISTICS AND QUALITY OF WATER IN THE MAJOR STREAMS WERE STUDIED IN THE LARAMIE BASIN, THE SHIRLEY BASIN, AND THE HANNA BASIN, ALL IN SOUTHEASTERN WYOMING. TREMENDOUS QUANTITIES OF WATER ARE PRESENT IN ROCKS UNDERLYING THE AREA. POROSITY, THERE WOULD BE IN EXCESS OF 64 ACRE-FEET OF WATER STORED IN A SANDSTONE 1 FOOT THICK AND 1 MILE SQUARE. GROUNDWATER SUITABLE IN QUANTITY AND QUALITY FOR STOCK USE IS GENERALLY AVAILABLE AT DEPTHS OF 500 FEET OR LESS. MOST WELLS FOR WHICH DATA ARE AVAILABLE ARE USED FOR STOCK OR DOMESTIC SUPPLIES. FLOW-DURATION CURVES SHOW THE DISTRIBUTION OF DAILY DISCHARGES FOR THE PERIOD FOR WHICH THE CURVE IS COMPILED. THERE IS, IN MOST PLACES, A FREE EXCHANGE OF WATER BETWEEN STREAMS AND FLOOD-PLAIN DEPOSITS TO THE EXTENT THAT ANY SIGNIFICANT CHANGE IN THE QUANTITY IN ONE WILL BE REFLECTED IN THE OTHER. NO AREAS WERE IDENTIFIED DURING THIS STUDY WHERE PERENNIAL STREAMS LOSE WATER TO BEDROCK FORMATIONS. THE MOST PREVALENT CONDITION IS TYPIFIED BY THAT IN THE LARAMIE BASIN. THERE, THE AREAL RELATIONS OF WATER IN BEDROCK TO WATER IN THE LITTLE LARAMIE AND LARAMIE RIVERS INDICATE THAT BEDROCK UNDERLYING THE FLOOD PLAIN OF THESE RIVERS IS NOT SUFFICIENTLY PERMEABLE TO MEASURABLY AFFECT THE FLOW OF THE LARAMIE RIVER BY EITHER INCREASING OR DECREASING DISCHARGE. (KNAPP-USGS)

An Evaluation of surface-mine spoils area restoration in Wyoming using Rainfall Simulation.
Lusby, G. C., and Toy, T. J., 1976
Earth Surface Processes, Vol. 1, p. 375-386, 1976, 4 Fig, 1 Tab, 9 Ref.

CHEMICAL QUALITY OF SURFACE WATER IN THE FLAMING GORGE RESERVOIR AREA, WYOMING AND UTAH
MADISON, R. J.; WADDELL, K. M.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
GEOLOGICAL SURVEY WATER-SUPPLY PAPER 2009-C, 1973. 18 P, 8 FIG, 1 PLATE, 3 TAB, 4 REF.,
Journal Announcement: SWRA0615
THE MAJOR INFLOW TO THE FLAMING GORGE RESERVOIR, WYOMING AND UTAH, IS FROM THE GREEN RIVER, WHICH CONTRIBUTES AN AVERAGE OF 81% OF THE WATER AND 59% OF THE INFLOW LOAD OF DISSOLVED SOLIDS. TOGETHER, BLACKS FORK AND HENRYS FORK CONTRIBUTE ABOUT 16% OF THE WATER AND ABOUT 23% OF THE DISSOLVED-SOLIDS LOAD, WHEREAS MINOR TRIBUTARIES CONTRIBUTE APPROXIMATELY 3% OF THE TOTAL INFLOW WATER TO THE RESERVOIR, BUT ABOUT 18% OF THE TOTAL INCOMING LOAD OF DISSOLVED SOLIDS. THE CONCENTRATION OF DISSOLVED SOLIDS IN CONCENTRATION OF THE 1962-66 INFLOW. THE INCREASED CONCENTRATION IS DUE MOSTLY TO LEACHING OF MINERALS FROM THE RESERVOIR BOTTOM. THE MAJOR DIFFERENCE BETWEEN THE CHEMICAL COMPOSITION OF THE INFLOW DURING 1963-66 AND THAT OF THE RESERVOIR IN 1966 IS AN INCREASE IN SULFATE AND A DECREASE IN BICARBONATE. IMPOUNDMENT CAUSED THE CONCENTRATION OF DISSOLVED SOLIDS IN THE RIVER SYSTEM TO INCREASE BY ABOUT 32%. EVAPORATION ACCOUNTED FOR AN

Geology and coal resources of the Buffalo-Lake DeSmet area, Johnson and Sheridan Counties, Wyoming
Mapel, W. J., 1959
U.S. Geological Survey Bulletin 1078, 148 p.

Preliminary reconnaissance of the southern Powder River Basin Uranium districts, Wyoming
Marie, J. R., Rucker, S. J., Freudenthal, P. B., and Ringen, B. H.
U.S. Geological Survey Water-Resources Investigations.

Mississippian rocks in the Laramie Range, Wyoming and adjacent areas, in short papers in geology and hydrology, Article 66
Maughan, E. K., 1963
U.S. Geological Survey Professional Paper 475-C, p. C23.

Preliminary map showing freshwater heads for the Mission Canyon and Lodgepole Limestones and equivalent rocks of Mississippian age in the Northern Great Plains of Montana, North and South Dakota, and Wyoming (Duplicated see Montana).

Miller, W. R., and Strausz, S. A., 1981a.
U.S. Geological Survey Water-Resources Investigations Open-File Map 80-729, 1 sheet.

Preliminary map showing freshwater heads for the Red River Formation, Bighorn Dolomite, and equivalent rocks of Ordovician age in the Northern Great Plains of Montana, North and South Dakota, and Wyoming. (Duplicated see Montana).
Miller, W. R., and Strausz, S. A., 1980b
U.S. Geological Survey Water-Resources Investigations Open-File Map 80-730, 1 sheet.

Reconnaissance of the geology and ground-water resources in the Cheyenne River drainage basin in northern Converse County, Wyoming
Morris, D. A., 1956
U.S. Geological Survey Open-File Report 14 p.

Preliminary report of ground water from an underground coal gasification experiment, Hanna, Wyoming
Peter, K. D.
U.S. Geological Survey Open-File Report.

Subsurface geology and porosity distribution, Madison Limestone and underlying formations, Powder River Basin, northeastern Wyoming and southeastern Montana, and adjacent areas
Peterson, J. A., 1978
U.S. Geological Survey Open-File Report 78-783, 9 p.

Stratigraphy and sedimentary facies of the Madison Limestone and associated rocks in parts of Montana, North Dakota, South Dakota, Wyoming, and Nebraska.
Peterson, J. A., 1981
U.S. Geological Survey Open-File Report 81-642, 92 p.

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming.
Rankl, J. G.
U.S. Geological Survey, Water Resources Investigation Report 81-76. 43 P.
This report describes a method to estimate infiltration rates of soils for use in estimating runoff from small basins.
Average rainfall intensity is plotted against storm duration on log-log paper. All rainfall events are designated as having

either runoff or nonrunoff. A power-decay-type curve is visually fitted to separate the two types of rainfall events. This separation curve is an incipient-ponding curve and its equation describes infiltration parameters for a soil.

For basins with more than one soil complex, only the incipient-ponding curve for the soil complex with the lowest infiltration rate can be defined using the separation technique. Incipient-ponding curves for soils with infiltration rates greater than the lowest curve are defined by ranking the soils according to their relative permeabilities and optimizing the curve position.

A comparison of results for six basins produced computed total runoff for all events used ranging from 16.6 percent less to 2.3 percent more than measured total runoff.

Rainfall and Runoff Data from Small Basins in Wyoming
Rankl, J. G.; Barker, D. S.
Geological Survey, Cheyenne, WY. Water Resources Div.
Wyoming Water Planning Program, State Engineer's Office, Cheyenne, Report No. 17, November 1977. 195 p, 2 fig, 9 ref.,
Journal Announcement: SWRA1116

Data for 392 rainfall and runoff occurrences in Wyoming are tabulated for years 1965 to 1973 for small, ephemeral streams having drainage areas of less than 11 square miles. Precipitation and discharge data, in 5-minute increments, are given for 392 flow events in 22 small-drainage basins. The data were collected for use in design of drainage structures for highways crossing ephemeral streams with small drainage areas. (Woodard-USGS)

Ground-Water Levels in Wyoming 1940-1971.
Ringen, Bruce H.
Publication of the Wyoming State Engineer and Wyoming Department of Economic Planning and Development Prepared by the U.S. Geological Survey. 479 P., 25 Illus., 1 Table, 1 Ref.

Report contains water-level measurements made in observation wells in Wyoming by the U.S. Geological Survey and cooperative state and Federal agencies during the period 1940-71. The data are listed by counties. Maps showing locations of the observation wells are included. Aquifers tapped by the observation wells are identified.

Records of Ground-Water Levels in Wyoming, 1972-73.
Ringen, Bruce H.
Publication of the Wyoming State Engineer and Wyoming Department of Economic Planning and Development Prepared by the U.S. Geological Survey. 165 P., 21 Illus., 1 Table, 2 Ref.

This report contains tables of water-level measurements made in observation wells in Wyoming by the U.S. Geological Survey in cooperation with State and Federal agencies during the period 1972-73. The data are listed by counties. Maps showing locations of the observation wells are included. Aquifers tapped by the observation wells are identified.

Effect on Sediment Yield and Water Quality of a Nonrehabilitated Surface Mine in North-Central Wyoming
Ringen, B. H.; Shown, L. M.; Hadley, R. F.; Hinkley, T. K.
Geological Survey, Cheyenne, WY. Water Resources Div., and Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-299 868, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-47, 1979. 23 p, 9 Fig, 7 Tab, 5 Ref.,
Journal Announcement: SWRA1303
Sediment and chemical quality of water data were collected from two adjacent drainage basins in northern Wyoming to compare hydrologic differences between an undisturbed basin and a surface-mined, virtually unrehabilitated basin. Rate of sediment accumulation in a pond in the basin that was surface mined for coal and left unrehabilitated was over 11 times greater than in a pond in the adjacent unmined basin. The additional sediment came primarily from barren high walls and roughly graded spoils. No sediment was yielded from ungraded spoil rows that drained to closed depressions. Most sediment yielded from the two basins was trapped in the two ponds. The chemical composition of materials from slopes, channels, and pond bottoms of the two basins were similar; however, concentrations of dissolved and suspended matter in waters of the two ponds were different. Low concentrations of dissolved chemical constituents in the pond water below the unmined basin suggest surface runoff as the source. Higher concentrations of dissolved chemical constituents, notably calcium, magnesium, and sulfate, in pond water below the mined area suggest ground-water discharge as the source. Sediment yield was a better indicator of the effects of disturbance on mined areas than chemical quality of water. (Woodard-USGS)

Coal of Laramie Basin, Wyoming
Siebenthal, C. E., 1907
U.S. Geological Survey Bulletin 316-D, p. 261-263

Permit requirements for development of energy and other selected natural resources for the State of Wyoming.
Smith, J. F., 1981a
U.S. Geological Survey Open-File Report 81-1287, 60 p.

Coal-Resource Development alternatives, residuals management, and impacts on the Water Resources of the Yampa River Basin, Colorado and Wyoming. Paper presented at symposium on water resources and Fossil Fuel production, held in Dusseldorf, Germany, September 7-8, 1976.
Steele, T. D., 1976

International Water Resources Association, 1976. 14 p. 1 Fig, 1 Tab, 17 Ref. 77-04994.

An overview of River-Basin assessment techniques in an energy-impacted region--Yampa River Basin, Colorado and Wyoming.
Steele, T. D., 1979
Vol. 3, No. 3, P. 151-171, 1979, 10 Fig, 2 Tab, 29 Ref. 80-01952.

AN ENVIRONMENTAL ASSESSMENT OF IMPACTS OF COAL DEVELOPMENT ON THE WATER SOURCES OF THE YAMPA RIVER BASIN, COLORADO AND WYOMING--PHASE-1 WORK PLAN (Duplicated see Colorado).
STEELE, T. D.; BAUER, D. P.; WENTZ, D. A.; WARNER, J. W.
GEOLOGICAL SURVEY, DENVER, COLO.
OPEN-FILE REPORT 76-367, MAY 1976. 17 P, 2 FIG, 3 TAB, 11 REF.,
Journal Announcement: SWRA0919

The Yampa River Basin, Colorado and Wyoming--a Preview to Expanded Coal-Resource Development and its Impacts on Regional Water Resources. (Duplicated see Colorado).
Steele, T. D.; Bauer, D. P.; Wentz, D. A.; Warner, J. W.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-300 815, Price codes: A07 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-126, September 1979. 133 p, 35 Fig, 16 Tab, 124 Ref.,
Journal Announcement: SWRA1307

Assessment of impacts of proposed coal-resource and related economic development on water resources, Yampa River basin, Colorado and Wyoming - A summary.
Steele, T. D., and Hillier, D. E., (compilers and editors), 1981
U.S. Geological Survey Circular 839, 56 p.
Expanded mining and use of coal resources in the Rocky Mountain region of the western United States will have substantial impacts on water resources, environmental amenities, and social and economic conditions. The U.S. Geological Survey has completed a 3-year assessment of the Yampa River basin, Colorado and Wyoming, where increased coal-resource development has begun to affect the environment and quality of life. Economic projections of the overall effects of coal-resource development were used to estimate water use and the types and amounts of waste residuals that need to be assimilated into the environment. Based in part upon these projections, several physical-based models and other semiquantitative assessment methods were used to determine possible effects upon the basin's water resources.

Depending on the magnitude of mining and use of coal resources in the basin, an estimated 0.7 to 2.7 million tons (0.6 to 2.4 million metric tons) of waste residuals may be discharged annually into the environment by coal-resource development and associated economic activities. If the assumed development of coal resources in the basin occurs, annual consumptive use of water, which was approximately 142,000 acre-feet (175 million cubic meters) during 1975, may almost double by 1990. In a related analysis of alternative cooling systems for coal-conversion facilities, four to five times as much water may be used consumptively in a wet-tower, cooling-pond recycling system as in once-through cooling. An equivalent amount of coal transported by slurry pipeline would require about one-third the water used consumptively by once-through cooling for in-basin conversion.

Current conditions and a variety of possible changes in the water resources of the basin resulting from coal-resource development were assessed. Basin population may increase by as much as threefold between 1975 and 1990. Volumes of wastes requiring treatment will increase accordingly. Potential problems associated with ammonia-nitrogen concentrations in the Yampa River downstream from Steamboat Springs were evaluated using a waste-load assimilative-capacity model. Changes in sediment loads carried by streams due to increased coal mining and construction of roads and buildings may be apparent only locally; projected increases in sediment loads relative to historic loads from the basin are estimated to be 2 to 7 percent.

Solid-waste residuals generated by coal-conversion processes and disposed of into old mine pits may cause widely dispersed ground-water contamination, based on simulation-modeling results. Projected increases in year-round water use will probably result in the construction of several proposed reservoirs. Current seasonal patterns of streamflow and of dissolved-solids concentrations in streamflow will be altered appreciably by these reservoirs. Decreases in time-weighted mean-annual dissolved-solids concentrations of as much as 34 percent are anticipated, based upon model simulations of several configurations of proposed reservoirs.

Detailed statistical analyses of water-quality conditions in the Yampa River basin were made. Regionalized maximum water-quality concentrations were estimated for possible comparison with future conditions. Using Landsat imagery and aerial photographs, potential remote-sensing applications were evaluated to monitor land-use changes and to assess both snow cover and turbidity levels in streams. The technical information provided by the several studies of the Yampa River basin assessment should be useful to regional planners and resource managers in evaluating the possible impacts of development on the basin's water resources.

AN ENVIRONMENTAL ASSESSMENT OF IMPACTS OF COAL DEVELOPMENT ON THE WATER RESOURCES OF THE YAMPA RIVER BASIN, COLORADO AND WYOMING--PHASE-II WORK PLAN. (DUPLICATED SEE COLORADO).
STEELE, T. D.; JAMES, I. C. II; BAUER, D. P.
GEOLOGICAL SURVEY, DENVER, COLO.
OPEN-FILE REPORT 76-368, MAY 1976. 33 P, 2 FIG, 2 TAB, 60 REF.,
Journal Announcement: SWRA0921

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Ground-Water Levels in Wyoming, 1977.
Stevens, Marvin D.
U.S. Geological Survey Open-File Report 78-605.

Ground-water levels are measured periodically in a network of observation wells in Wyoming, principally in areas where ground water is used for irrigation or municipal purposes. In areas of heavy ground-water pumpage, mass measurements of water levels are made, usually in January, February, or March. However, sometimes weather conditions prevent reaching some wells until April. The time selected for measuring is when recovery of water levels from pumping effects of the previous irrigation season is virtually complete. These water-level measurements indicate changes in ground-water storage when compared with previous measurements. Water levels measured in about 240 wells during the first 4 months of 1978 were compared with measurements made during the same period in 1977 to give the net change in water levels for this period. These net changes along with depth to water in 1978 are shown in tables and on maps.

Water levels were measured periodically in about 290 wells for a total of about 1,150 measurements in 1977. Twenty-three wells were equipped with water-stage recorders in 1977. Hydrographs of most wells in the observation-well network were made using periodic measurements or the highest water levels recorded for the first and fifteenth day of each month for those wells equipped with water-stage recorders.

Five previous reports of ground-water levels in Wyoming were compiled by the U.S. Geological Survey (Ringen, 1973; Ringen, 1974; Ballance and Freudenthal, 1975; Ballance and Freudenthal, 1976; and Ballance and Freudenthal, 1977).

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POTENTIAL OF MADISON GROUP AND ASSOCIATED ROCKS TO SUPPLY INDUSTRIAL WATER NEEDS, POWDER RIVER BASIN, WYOMING AND MONTANA
SWENSON, F. A.
GEOLOGICAL SURVEY, DENVER, COLO.
IN: WATER RESOURCES PROBLEMS RELATED TO MINING: AMERICAN WATER RESOURCES ASSOCIATION PROCEEDINGS SERIES NO 18, P 210-218, JUNE 1974. 5 FIG, 4 REF.,
Journal Announcement: SWRA0902

A LARGE PART OF THE NATION'S ENERGY RESERVES ARE IN THE COAL DEPOSITS OF THE POWDER RIVER BASIN IN WYOMING AND MONTANA. ONE OF THE LIMITING FACTORS OF INDUSTRIAL DEVELOPMENT OF THESE GREAT ENERGY RESERVES IS THE AVAILABILITY OF WATER. SURFACE-WATER SUPPLIES THAT HAVE NOT BEEN APPROPRIATED FOR

OTHER USES WITHIN THE BASIN ARE LIMITED. A RECONNAISSANCE STUDY BEGAN IN JULY 1973 TO ASSESS THE POTENTIAL OF THE MADISON GROUP AND OTHER DEEP CARBONATE AQUIFERS TO SUPPLY WATER NEEDS FOR ENERGY DEVELOPMENT OF THE POWDER RIVER STRUTURAL BASIN THAT LIES BETWEEN THE BLACK HILLS AND THE BIGHORN-PRYOR MOUNTAINS, EXTENDING FROM ABOUT CASPER, WYOMING, TO THE YELLOWSTONE RIVER IN MONTANA. MAPS HAVE BEEN PREPARED OF THIS AREA SHOWING (1) THICKNESS OF MADISON GROUP, PLUS ADDITIONAL CARBONATE AQUIFERS UNDERLYING AND IN HYDROLOGIC CONTINUITY WITH MADISON, (2) STRUCTURE CONTOURS SHOWING TOP OF MADISON GROUP, (3) POTENTIOMETRIC MAP SHOWING THE HEIGHTS TO WHICH WATER WILL RISE IN TIGHTLY CASED WELLS BOTTOMED IN THE MADISON AND OTHER CARBONATE AQUIFERS, AND (4) A MAP SHOWING LINES OF EQUAL DISSOLVED-SOLIDS CONCENTRATION IN WATER FROM THE CARBONATE AQUIFERS. ABOUT 40 WATER WELLS, SOME YIELDING MORE THAN 9,000 GALLONS PER MINUTE, WITH MAXIMUM DEPTHS EXCEEDING 10,000 FEET HAVE BEEN COMPLETED. THE GOOD QUALITY OF THE WATER (FOR EXAMPLE, 860 MILLIGRAMS PER LITRE DISSOLVED SOLIDS IN WATER FROM A DEPTH OF 8,000 FEET AND 80 MILES FROM AREA OF RECHARGE) TENDS TO INDICATE GOOD CIRCULATION OF WATER. IT APPEARS THAT SIGNFICANT QUANTITIES OF WATER CAN BE MADE AVAILABLE FROM THESE DEEP AQUIFERS FOR INDUSTRIAL DEVELOPMENT OF THE ENERGY RESERVES OF THIS AREA. (WOODARD-USGS)

Land and Coal ownership in the Gillette area, Wyoming.
U.S. Geological Survey, 1973
U.S. Geological Survey Miscellaneous Investigations Map I-848-B.

Stripping coal deposits of the northern Great Plains, Montana, Wyoming, North Dakota, and South Dakota.
U.S. Geological Survey, 1974
U.S. Geological Survey Miscellaneous Field Studies Map MF-590, 1 sheet.

Plan of study of the hydrology of the Madison Limestone and associated rocks in parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming.
U.S. Geological Survey, 1975
U.S. Geological Survey Open-File Report 75-631, 37 p.

Coal Fields of east-central Carbon County, Wyoming.
Veatch, A. C., 1907
U.S. Geological Survey Bulletin 316-D, p. 244-260.

Reconnaissance of the geology and ground-water resources of the Pass Creek Flats area, Carbon County, Wyoming.
Visher, F. N., 1952

U.S. Geological Survey Circular 188, 19 p.

Physical, Chemical, and Biological Relations of Four Ponds in the Hidden Water Creek Strip-Mine Area, Powder River Basin, Wyoming
Wangsness, D. J.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-273 512, Price codes: A03 in paper copy, A01 in microfiche. Water-Resources Investigations 77-72, July 1977. 48 p, 8 fig, 9 tab, 15 ref.,
Journal Announcement: SWRA1109
The Hidden Water Creek area in Wyoming was mined from 1944 to 1955 and abandoned. The open pits filled with water and pond-type ecosystems developed. Light was transmitted to greater depths within two control ponds located outside the mine area. The lower light transmittance in the ponds within the mined area probably was due, in part, to the greater number of phytoplankton cells. Also, unconsolidated soil material within the mine area was observed to slough off the pond banks, which could add to the concentration of suspended sediments. Dissolved oxygen concentrations were lower in the ponds within the mined area. Most of the major ions (calcium, magnesium, sulfate, and sodium) were present in greater concentrations in the ponds within the mined area. Higher concentrations of bicarbonate and total hardness were in the water within the mined area. Biological communities were less diverse and chemical concentrations fluctuated more in the mined area than in the ponds outside the mined area. (Woodard-USGS)

Physical, chemical, and biological relations in a potential coal surface-mine area, Clear Creek Drainage, Powder River Basin, Wyoming
Wangsness, D. J.
U.S. Geological Survey Open-File Report (author transferred - rough draft not completed).

Biological reconnaissance of the Powder River structural basin, Wyoming
Wangsness, D. J.,
U.S. Geological Survey Open-File Report (author transferred - rough draft not completed).

Geology and ground-water resources of the Kaycee area, Wyoming
Warner, D. A., 1947
U.S. Geological Survey Open-File Report, 9 p.

Ground-water reconnaissance of the Great Divide and Washakie Basins and some adjacent areas, southwestern Wyoming
Welder, G. E., and McGreevy, L. J., 1966
U.S. Geological Survey Hydrologic Investigations Atlas HA-219, 10 p., 3 sheets.

GROUNDWATER RECONNAISSANCE OF THE GREEN RIVER BASIN, SOUTHWESTERN WYOMING
WELDER, GEORGE E.
GEOLOGICAL SURVEY, WASHINGTON, D.C.
FOR SALE BY U GEOLOGICAL SURVEY, WASHINGTON, DC 20242-PRICE $1.00. GEOLOGICAL SURVEY HYDROLOGIC INVESTIGATIONS ATLAS HA-290, 3 SHEETS, 1968. TEXT, 6 FIG, 5 MAP, 2 TAB.,
Journal Announcement: SWRA0412
THIS REPORT, CONSISTING OF A HYDROLOGIC ATLAS OF 5 MAPS ON 2 SHEETS AND A SEPARATE TEXT, DESCRIBES THE OCCURRENCE AND QUALITY OF GROUNDWATER IN THE GREEN RIVER STRUCTURAL BASIN OF WYOMING. SOME GENERAL INFORMATION RELATIONSHIP OF GROUNDWATER TO SURFACE WATER IN PARTS OF THE BASIN. THE AREA CONSISTS OF APPROXIMATELY 10,000 SQUARE MILES, WHICH IS ABOUT 60% OF THE WYOMING PART OF THE GREEN RIVER DRAINAGE BASIN. THE ROCKS THAT UNDERLIE THE AREA RANGE IN AGE FROM PRECAMBRIAN TO RECENT. ROCKS AT THE SURFACE ARE DIVIDED AS FOLLOWS: 82% OF TERTIARY AND QUATERNARY AGE, 2% OF PALEOZOIC AND MESOZOIC AGE, AND 16% OF PRECAMBRIAN AGE. RECHARGE TO GROUNDWATER RESERVOIRS IS MAINLY BY SEEPAGE FROM PRECIPITATION AND STREAMS. YIELDS OF MOST WELLS RANGE FROM ABOUT 10 TO 100 GPM. THE QUALITY OF GROUNDWATER RANGES FROM VERY POOR TO EXCELLENT WITH A RANGE OF DISSOLVED SOLIDS FROM LESS THAN 500 TO MORE THAN 3,500 PPM. THE WATER IN MOST OF THE PERENNIAL STREAMS CONTAINS LESS THAN 500 PPM TOTAL DISSOLVED SOLIDS. TWO EXCEPTIONS ARE THE REACHES OF BIG SANDY CREEK BELOW THE EDEN-FARSON IRRIGATION PROJECT AND BLACKS FORK BELOW THE LYMAN IRRIGATION PROJECT. TOTAL DISSOLVED SOLIDS IN THE SURFACE WATER OF THESE REACHES GENERALLY EXCEED 1,500 PPM. (WOODARD-USGS)

Analysis of Stream Quality in the Yampa River Basin, Colorado and Wyoming. (Duplicated see Colorado).
Wentz, D. A.; Steele, T. D.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-108904, Price codes: A08 in paper copy, A01 in microfiche. Geolgical Survey Water-Resources Investigations 80-8, April 1980. 161 p, 80 Fig, 17 Tab, 59 Ref.,
Journal Announcement: SWRA1404

Ground-water Resources and Geology of Niobrara County, Wyoming.

Whitcomb, Harold A.
U.S. Geological Survey Water Supply Paper 1788.

Niobrara County occupies an area of about 2,600 square miles in east-central Wyoming. The region lies in the western part of the High Plains and is characterized by rolling grasslands, isolated low mountains, and local badlands. The climate is typical of the northern High Plains--a region of low precipitation, high rate of evaporation, and a wide range in temperature. The economy of Niobrara County is based principally on ranching and farming.

The rocks exposed in Niobrara County are mostly sedimentary deposits that range in age from Cambrian to Recent. Igneous and metamorphic rocks of Precambrian age crop out in the core of the Hartville uplift in the southcentral part of the county. Throughout much of the area, older rocks are overlain by deposits of Late Cretaceous and Tertiary age. Aquifers of pre-Cretaceous age generally lie too deep to be considered potential sources of ground water in the area.

The 150 to 300 feet of interbedded sandstone and shale that composes the basal unit of the Cretaceous System in Niobrara County is designated as the Inyan Kara Group in the northern part of the report area and the Cloverly Formation in the southwestern part. Although the correlation between these formations has not been established, they are believed by some authors to be lithogenetic equivalents. In this report, the Inyan Kara Group and the Cloverly Formation are considered to be a single hydrologic unit having similar water-bearing characteristics. The Inyan Kara Group and Cloverly Formation yield small quantities of water to domestic and stock wells drilled in or near areas of outcrop and moderate quantities to wells supplying the Lance Creek oil field. The water is generally under artesian pressure, and one of the Lance Creek wells flowed when completed.

The Inyan Kara Group is overlain by as much as 4,500 feet of principally shale and claystone of Cretaceous age. These deposits are not considered to be water bearing except for small quantities of water that might be obtained from the Newcastle Sandstone where it crops out on the eastern flank of the Old Woman anticline.

The Fox Hills Sandstone of Late Cretaceous age yields small quantities of water to stock and domestic wells in the northeastern part of Niobrara County. The water is under artesian pressure, and wells drilled along the western border of the outcrop might flow. The generally steep dip of the beds causes the formation to lie at progressively increasing depths west of the Fox Hills-Lance contact. The formation is about 500 feet thick in the southern part of the outcrop and apparently thins northward.

The Lance Formation of Late Cretaceous age and the Fort Union Formation of Paleocene age are the principal sources of stock and domestic water in the northwestern part of Niobrara County. In most areas, the yield to wells may be expected to increase with depth and the number of water-bearing beds penetrated. The thickness of the formations increases from a thin eroded edge along the east margins of their outcrops to an estimated combined thickness of about 4,000 feet at the county line between Niobrara and Converse Counties.

The White River Group of Oligocene age, which unconformably overlies older rocks ranging in age from Early Cretaceous to Paleocene, yields small quantities of water to stock and domestic wells in the central part of the report area. Larger quantities might be obtained from coarse channel deposits that occur at some places in the formation. The thickness of the White River Group ranges from a thin edge overlapping older rocks to about 550 feet in the eastern part of the outcrop area.

The Arikaree Formation of Miocene age is the only known source of large quantities of ground water in Niobrara County. It yields water to many stock and domestic wells, 16 irrigation wells, and the wells supplying the communities of Lusk and Manville. Most of the irrigation wells are capable of yielding as much as 500 gpm (gallons per minute) and several would probably produce 1,000 gpm with suitable pumping equipment. Even larger yields may be expected from wells penetrating greater saturated thicknesses of the aquifer. The Arikaree is thin where it wedges out against the Hartville uplift but is estimated to be 600 to 700 feet thick in the vicinity of the Nebraska State line.

The Alluvial deposits of Quaternary age in the valleys of the Cheyenne River and Lance Creek yield water to a few stock and domestic wells and to several irrigation wells. These deposits are the principal potential source of moderate to large quantities of ground water in the northern part of Niobrara County. Reported yields of irrigation wells range from 170 to 300 gpm, and wells of larger capacity probably can be developed in some areas. The thickness of the alluvium ranges from a few feet in the upper reaches of Lance Creek to a reported 100 feet near the confluence with the Cheyenne River.

Most of the water utilized in Niobrara County is obtained from drilled wells because surface-water supplies are ephemeral and unpredictable. Some water is pumped for irrigation from Lance Creek and the Cheyenne River during periods of intermittent flow, and perennial flow in the Niobrara River provides water for irrigation along the lower reaches in Niobrara County. In most areas the pumpage of ground water could be increased appreciably without noticeably affecting water levels or seriously decreasing the quantity of water in storage.

Recharge to the ground-water reservoir is principally from precipitation, which averages about 15 inches per year in Niobrara County. Recharge to the Arikaree Formation has been estimated to be only about 0.33 inch per year; probably, a somewhat smaller amount reaches the ground-water reservoir in the finer grained rocks underlying most of the northern part of the county.

Ground-water discharge in Niobrara County is principally by underflow through the aquifers. Smaller quantities are discharged by springs and seeps, evapotranspiration, and discharge from wells. Approximately 5 to 8 million gallons of water per day moves as underflow through the Arikaree Formation eastward across the Nebraska State line. Appreciably larger quantities of ground water probably move westward through the Fox Hills Sandstone and the Lance and Fort Union Formations into the Powder River Basin. A study of the use of ground water by cottonwood trees along Lance Creek indicates that at least 4 million gallons of ground water is withdrawn daily from alluvial deposits.

Ground-Water Resources and Geology of Northern and Central Johnson County, Wyoming.
Whitcomb, Harold A., Cummings, T. Ray, and McCullough, Richard A.
U.S. Geological Survey Water-Supply Paper 1806.
Northern and central Johnson County, Wyo., is an area of about 2,600 square miles that lies principally in the western part of the Powder River structural basin but also includes the east flank of the Bighorn Mountains. Sedimentary rocks exposed range in age from Cambrian to Recent and have an average total thickness of about 16,000 feet. Igneous and metamorphic rocks of Precambrian age crop out in the Bighorn Mountains. Rocks of pre-Tertiary age, exposed on the flanks and in the foothills of the Bighorns, dip steeply eastward and lie at great depth in the Powder River basin. The rest of the project area is underlain by a thick sequence of interbedded sandstone, siltstone, and shale of Paleocene and Ecocene age. Owing to the Regional structure, most aquifers in Johnson County contain water under artesian pressure.

The Madison Limestone had not been tapped for water in Johnson County at the time of the present investigation (1963), but several wells in eastern Big Horn and Washakie Counties, on the west flank of the Bighorn Mountains, reportedly have flows ranging from 1,100 to 2,600 gallons per minute. Comparable yields can probably be obtained from the Madison in Johnson County in those areas where the limestone is fractured or cavernous. The Tensleep Sandstone reportedly yields 600 gallons per minute to a pumped irrigation well near its outcrop in the southwestern part of the project area. Several flowing wells tap the formation on the west flank of the Bighorn Mountains. The Madison Limestone and the Tensleep Sandstone have limited potential as sources of water because they can be developed economically only in a narrow band paralleling the Bighorn Mountain front in the southwestern part of the project area.

Overlying the Tensleep Sandstone is about 6,000 feet of shale, siltstone, and fine-grained sandstone that, with a few exceptions, normally yields only small quantities of water to wells. The Cloverly Formation and the Newcastle Sandstone may yield moderate quantities of water to wells; but, in some areas, properly constructed wells tapping both formations might yield large quantities of water. The Shannon Sandstone Member of the Cody Shale will probably yield only small quantities of water to wells, but it is the best potential source of ground water in the stratigraphic interval between the Newcastle and Parkman Sandstones.

The Parkman Sandstone and the Lance Formation yield water to relatively shallow wells principally in the southwestern part of the project area. The Fort Union Formation yields adequate supplies of water for stock and domestic use from relatively shallow wells near its outcrop almost everywhere in the county. A few deep wells tap the Fort Union along the Powder River valley in the northeastern part of Johnson County. Some of these wells flow, but their flows rarely exceed 10 gallons per minute; larger yields could be undoubtedly be obtained by pumping.

The Wasatch Formation is the principal source of ground water in Johnson County. It yields adequate supplies to many relatively shallow stock and domestic wells, some of which flow, but much larger yields probably would require pumping lifts that are prohibitive for most purposes. The Kingsbury Conglomerate and Moncrief Members of the Wasatch Formation, though, may yield moderate quantities of water in some places.

Alluvial deposits underlying the valleys of the Powder River and Crazy Woman, Clear, and Piney Creeks are potential sources of moderate to large supplies of water in the Powder River drainage basin. The permeability of these deposits decreases with distance from the Bighorn Mountain front, so that largest yields can probably be obtained along the upper reaches of these streams.

Most ground water utilized in the project area is for domestic and stock supplies and is obtained from drilled wells and from springs. Water for irrigation is obtained almost entirely by diverting flows of perennial streams. The discharge of wells and springs is small compared to the amount of ground water available, and pumpage generally could be increased considerably without noticeably affecting the quantity of ground water in storage. Overdevelopment of water in the alluvium of the upper reaches of Crazy Woman, Clear, and Piney Creeks, however, might seriously reduce the amount of surface water that currently is available for irrigation.

Water from Precambrian rocks, the Tensleep Sandstone, glacial deposits, and alluvial deposits in the western part of the project area is generally of good quality for domestic, irrigation, and stock use. Water from the Frontier Formation, the Lance Formation, and alluvial deposits in the eastern part of the project area is of poor quality for domestic use and of fair to poor quality for stock use. The water is unsuitable for irrigation under ordinary conditions because of its very high salinity hazard. Water From the Parkman Sandstone is usable as a domestic supply but has limited suitability for irrigation because of its high salinity and high sodium hazards. As a source for stock supplies, the Parkman Sandstone yields water of fair quality. Water from the Cody Shale is unsuitable for most uses.

Water from the Fort Union and Wasatch Formations is usable for domestic purposes, although at many locations the water does not meet suggested domestic standards with respect to dissolved solids, iron, manganese, and sulfate. Hydrogen sulfide is an objectionable constituent of water from some wells. The water generally is unsuitable for irrigation, either because of its high sodium and high bicarbonate content or because of its high salinity hazard. It ranges from good to poor quality for stock use.

GROUND-WATER RESOURCES AND GEOLOGY OF THE WIND RIVER BASIN AREA, CENTRAL WYOMING
WHITCOMB, HAROLD A.; LOWRY, MARLIN E.
US GEOLOGICAL SURVEY.
U S GEOL SURV HYDROL INVEST ATLAS HA-270, 13 P, 1968. 1 MAP, 1 CHART, 29 REF.,
Journal Announcement: SWRA6801

THE WIND RIVER BASIN IS A 12,000-SQ-MI AREA IN CENTRAL WYOMING WHERE CLIMATE RANGES FROM HUMID TO ARID. THE BASIN, A STRUCTURAL DEPRESSION UPLIFTED AND FAULTED ALONG THE MARGINS, CONTAINS SEVERAL THOUSAND FT OF TERTIARY ROCKS. MOUNTAINS AROUND THE BASIN ARE FORMED BY ROCKS, PRECAMBRIAN TO CRETACEOUS, WHICH DIP BENEATH THE BASIN. GROUNDWATER OCCURS UNDER BOTH WATER-TABLE AND ARTESIAN CONDITIONS. PRINCIPAL WATER-BEARING UNITS ARE ALLUVIAL DEPOSITS AND TERTIARY SANDSTONES (ARIKAREE AND WIND RIVER FORMATIONS), WHICH HAVE THE POTENTIAL TO YIELD LARGE QUANTITIES OF WATER AT PLACES. THE TERTIARY FORT UNION FORMATION AND SEVERAL OF THE PRE-TERTIARY FORMATIONS ALSO YIELD WATER LOCALLY. QUALITY OF THE GROUNDWATER VARIES FROM LOW IN MINERAL CONTENT AND SUITABLE FOR DOMESTIC USE TO UNUSABLE FOR STOCK SUPPLIES. GROUNDWATER LOCALLY CONTAINS UNDERSIRABLE AMOUNTS OF DISSOLVED SOLIDS, FLUORIDE, CHLORIDE, SODIUM, OR HYDROGEN SULFIDE. WATER IN ALLUVIAL DEPOSITS UNDERLYING THE RIVERTON IRRIGATION PROJECT AREA IS HIGHLY MINERALIZED DUE TO IRRIGATION RETURN FLOW. ANALYSES OF WATER ARE GIVEN IN A TABLE, AND THE LITHOLOGIC AND HYDROLOGIC CHARACTERISTICS OF GEOLOGIC FORMATIONS, ON A CHART. MAPS AT 1:250,000 SHOW GEOLOGY, PIEZOMETRIC CONTOURS, WELL DATA, AND SPECIFIC CONDUCTANCE OF WATER.

Water Resources Data for Wyoming, Published annually since 1975.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161.

Water Resources data for Wyoming consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells.

Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. This data represents that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Wyoming. (USGS)

WATER RESOURCES INVESTIGATIONS IN WYOMING, 1968
GEOLOGICAL SURVEY, WASHINGTON, D.C.
GEOLOGICAL SURVEY REPORT OF INVESTIGATIONS FOLDER, 1 SHEET, 1969. 6 FIG, 1 MAP.,
Journal Announcement: SWRA0521
THE WATER RESOURCES STUDIES AND INVESTIGATIONS OF THE U. S. GEOLOGICAL SURVEY IN WYOMING ARE SUMMARIZED. A SELECTED BIBLIOGRAPHY OF MATERIAL CONCERNING THE STATE IS INCLUDED. A LIST IS GIVEN OF STATE AND FEDERAL AGENCIES, COUNTIES, AND CITIES WHO COOPERATE IN DIFFERENT PARTS OF THE PROGRAM. THE HYDROLOGIC DATA NETWORK CONSISTS OF 216 PRIMARY, SECONDARY, AND WATER MANAGEMENT STREAMFLOW STATIONS; 238 GROUNDWATER OBSERVATION WELLS; AND 91 WATER QUALITY OBSERVING SITES. SMALL STATE MAPS SHOW PRINCIPAL SOURCES OF GROUNDWATER, MEAN ANNUAL PRECIPITATION, AVERAGE ANNUAL RUNOFF, SEDIMENT CONCENTRATION OF RIVERS, DISCHARGE OF THE PRINCIPAL RIVERS, AND THE DISSOLVED SOLIDS IN MAJOR STREAMS. A MAP, SCALE 42 MI TO THE INCH, SHOWS BY SYMBOLS, NUMBERS, AND COLORED OUTLINE THE HYDROLOGIC DATA NETWORK AND INVESTIGATIONS IN WYOMING IN DECEMBER 1968. (WOODARD-USGS)

WATER RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN THE NORTHERN GREAT PLAINS COAL REGION OF WYOMING, MONTANA, AND NORTH DAKOTA, 1975
GEOLOGICAL SURVEY, DENVER, COLO. WATER RESOURCES DIV.
OPEN-FILE REPORT, MAY 1975. 110 P, 27 FIG, 27 REF.,
Journal Announcement: SWRA0824
THE GEOLOGICAL SURVEY'S WATER RESOURCES DIVISION HAS FOR MANY YEARS MAINTAINED A PROGRAM OF WATER-RESOURCES INVESTIGATIONS THAT INCLUDES THE COAL REGIONS OF WYOMING, MONTANA, AND NORTH DAKOTA. THE RECENT INTEREST IN COAL HAS ADDED NEW DIMENSIONS AND GREATER INTENSITY TO THE INVESTIGATIONS. THE WORK HAS EXPANDED TO INCLUDE MONITORING THE ENVIRONMENTAL EFFECTS OF COAL MINING AND PROCESSING AND TO DETERMINE THE AVAILABILITY OF ADDITIONAL WATER SUPPLIES FOR COAL-CONVERSION PLANTS AND RELATED DEMANDS. THIS REPORT DESCRIBES THE WATER-RESOURCES INVESTIGATION PROGRAM THAT IS CURRENTLY IN OPERATION. LOCATIONS OF GAGING STATIONS AND WATER-QUALITY MEASURING SITES, FREQUENCIES AND PARAMETERS, AND AREAS OF GROUNDWATER STUDIES ARE INCLUDED. BRIEF DESCRIPTIONS OF COAL-RELATED STUDIES BY INVESTIGATORS WHO ARE HEADQUARTERED OUTSIDE THE NORTHERN GREAT PLAINS COAL REGIONS ARE ALSO INCLUDED. SUCH STUDIES ARE RESEARCH IN TOPICS RELATED TO COAL EXTRACTION, WATER SUPPLY, AND POST-MINING RECLAMATION. (WOODARD-USGS)

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN THE MAJOR COAL AND OIL SHALE AREAS OF WYOMING, 1975-76

GEOLOGICAL SURVEY, CHEYENNE, WYO.

OPEN-FILE REPORT, JANUARY 1976. 43 P, 10 FIG, 5 TAB, 44 REF.,

Journal Announcement: SWRA0918

THE U.S. GEOLOGICAL SURVEY, IN COOPERATION WITH THE STATE OF WYOMING AND OTHER FEDERAL AGENCIES, HAS FIVE DATA-COLLECTION ACTIVITIES AND FOURTEEN WATER-RESOURCE APPRAISAL PROJECTS IN THE MAJOR COAL AND OIL SHALE AREAS OF WYOMING. THESE ACTIVITIES ARE LOCATED PRIMARILY IN THE NORTHERN GREAT PLAINS COAL REGION OF NORTHEASTERN WYOMING (THE POWDER RIVER STRUCTURAL BASIN) AND THE GREEN RIVER, BEAR RIVER, AND GREAT DIVIDE BASINS OF CONTINUOUS RECORDS OF STREAMFLOW AND RESERVOIR STORAGE; (2) PEAK FLOW INFORMATION AT PARTIAL-RECORD SITES; (3) SAMPLING AND CHEMICAL ANALYSES OF WATER FROM STREAMS AND WELLS; (4) SAMPLING AND SEDIMENT ANALYSIS OF WATER FROM STREAMS; AND (5) MEASUREMENTS OF WATER LEVELS IN WELLS. THIS REPORT CONTAINS LISTS OF MONITORING SITES FOR THESE FIVE DATA-COLLECTION ACTIVITIES. (WOODARD-USGS)

Hydrology of Area 35, Eastern Region, Interior Coal Province, Illinois and Kentucky.

Zuehls, E. E., Ryan, G. L., Peart, D. B., and Fitzgerald, K. K., 1981.

U.S. Geological Survey Water-Resources Investigations Open-File Report 81-403, 68 p.

**Beans Spring, Table, and Black Butte Creek Projects Preference Right Lease Applications, southwestern Wyoming**
**BLM, Rock Springs, Wyoming**
**FEA, 1982**

About 51 million tons of coal would be surface-mined in Sweetwater County, in three mines--Beans Spring, 35 miles south; Table, 19 miles northeast; and Black Butte Creek, 25 miles southeast of Rock Springs. The three proposed mines are on the Rock Springs Uplift, a semiarid high plateau characterized by high evaporation, wind speeds and percentage of possible sunshine. Coal in the Beans Spring and Table areas is in the late Cretaceous Almond Formation. The Black Butte Creek coal is in the Lance and Fort Union Formations. The Beans Springs area is drained by tributaries to through-flowing Gap and Salt Wells Creeks. The Table area is in the headwaters of tributaries to Killpecker Creek. The Black Butte Creek area is drained by tributaries to through-flowing Black Butte Creek. Erosion and sedimentation is a problem in the Table and Black Butte Creek areas. The mines are in groundwater recharge areas but recharge is small because of high evaporation rates. Groundwater occurs under both confined and unconfined conditions. Large withdrawals probably would exceed recharge and lower water levels. Mining would increase sediment loading of streams. Spoil leachate would affect groundwater quality within one mile of the mines.

**Proposed Buckskin Project**
**IN: Eastern Powder River Coal DES**
**BLM, Cheyenne, Wyoming**
**DES, 1978**

This document analyzes the impacts of approval of a mining and reclamation plan to recover 80 million tons of 84 million tons of federally leased surface minable coal in the Powder River Basin, in northeastern Wyoming, over 20 years. The site, proposed Buckskin Mine, consists of 600 acres 10 miles north of Gillette in Campbell County. Most of the site is a gentle south slope, dissected by intermittent Rawhide Creek (69 square mile upstream drainage area, average flow 0.8 cubic feet per second) and ephemeral Spring Draw (drainage area 2.13 square miles). Maximum relief near Rawhide Creek is about 150 feet. Annual precipitation of 15 to 16 inches results in 14 gallons per minute runoff. The coal occurs in two seams at the top of the Fort Union Formation: the Anderson seam, about 40 feet thick, separated by 3 feet of shale from the underlying Canyon seam, about 64 feet thick. The coal is overlain by 0 to 215 feet of the Wasatch Formation. The beds dip less than two degrees southwest into the Basin. Small quantities of water are in the coals and discontinuous sandstones in the Wasatch Formation. The site contains 6 shallow wells, 5 reservoirs, irrigation ditches and spreader dams. Both surface and ground water is too highly mineralized (4,000 to 6,000 milligrams per liter dissolved solids) for human consumption. Surface mining would require dewatering 400 gallons per minute during years 3 to 4, reducing to 260 gallons per minute during the 16th year. About 30 gallons per minute would be used. The remainder would be discharged to Rawhide Creek after treatment. Dewatering of the sandstone would extend 1,000 to 1,500 feet. The coal dewatering would extend about 3 miles from the site. About 456 acres of shallow aquifers would be modified, resulting in a deterioration of water quality.

Proposed Coal Leasing in the Carbon Basin Area, Wyoming
BLM, Cheyenne, Wyoming
FES, 1979

This statement analyzes impacts of leasing 6,146 acres of Federal coal in the Carbon Basin, interspersed among private coal, in order to create logical mining units. The surface of the basin is characterized by a northeast-trending ridge, maximum relief 400 feet, dissected by ephemeral Second and Third Sand Creeks and Chapman Draw draining eastward to the Medicine Bow River, and by First Sand Creek, also ephemeral, a closed basin. These creeks are estimated to flow only 10 to 15 days per year. Annual precipitation is 10 inches and lake evaporation ranges from 36 to 42 inches per year. The coal, in the Paleocene-Eocene Hanna Formation, crops out on the southern end of the Basin. The main coal, the Johnson Bed, ranges from 8 to 22 feet thick. Two other coals, the Finch Group, more than 13 feet thick locally, and the Blue Group, more than 13 feet thick locally, overlie the Johnson Bed. About 10 million tons could be surface-mined to a depth of 150 feet and 95 to 98 percent of less than 400 million tons could be recovered underground by continuous and longwall mining. The coal beds and overlying sandstones are poorly productive aquifers, confined toward the basin center. Aquifers in the deeper Mesa Verde Formation are isolated from the Hanna Formation by the intervening Lewis Shale. Surface mining would remove one shallow well, seven stock ponds and two surface diversions. A maximum mine inflow of 40,000 gallons per day would have to be handled. Water in four test holes ranged from 672 to 8,084 milligrams per liter total dissolved solids.

Cherokee Proposed Project
BLM, Cheyenne, Wyoming
IN: Development of Coal Resources in Southcentral Wyoming, FES, 1978

The proposed Cherokee surface mine of 10,671 acres 30 miles west-southwest of Rawlins in Carbon and Sweetwater Counties, is near the Continental Divide, the saddle between the Great Divide and Washakie Basins. The relatively level landscape is underlain by nearly horizontal beds of the Fort Union/Wasatch Formation which contains two main coal seams, 12 and 14 feet thick. Annual precipitation of 10 inches produces probably poor quality ephemeral runoff of less than 0.17 inches to closed basins. Small amounts of poor quality, dissolved solids 2,040 to 3,760 milligrams per liter occur in the coals and lenticular sandstone above. Potentially 500 gallons per minute of water containing less than 1,000 milligrams per liter of dissolved solids could be obtained from a well in the Fort Union basal sandstone at a depth of about 3,500 feet. Mining would destroy two or three stock reservoirs and moist coal washing wastes conceivably could contaminate heavily mineralized ground water in Cow Butte Basin, a small playa, less than one square mile.

### Eastern Powder River Coal
BLM, Cheyenne, Wyoming
DES, 1978

This statement updates the Final Environmental Impact Statement, Eastern Powder River Coal Basin of Wyoming (FES 74-55). It evaluates impacts of surface coal mining and related activities by the year 1990 at three levels, 1) low--169 million tons per year from 14 surface mines presently operating or pending approval, 2) probable--173 million tons per year, one additional mine, and 3) high--15 existing or pending mines and 23 new mines producing 329 million tons per year, and one gasification plant. It also evaluates site-specific impacts of the one mine responsible for the probable level. The study area is the eastern flank of the Powder River Basin in Wyoming, comprising about 5 million acres, bound on the east by the coal outcrop, on the south by the North Platte River, on the west by the Powder River, and on the north by the Montana-Wyoming state line. The northern part of the area is characterized by high, open, rolling hills having relief of 500 to 1,000 feet. The southern part is plains and table land with relief of 300 to 500 feet. The Powder and Little Powder Rivers drain the north, Donkey Creek and Belle Fourche River drain the middle, and South Fork, Cheyenne River, Lance Creek and North Platte River tributaries drain the south. Streams are generally ephemeral but some have isolated intermittent reaches. Annual precipitation increases from less than 12 inches in the south to 17 inches in the northwest. More than 73 billion tons of minable (less than 300 feet deep) coal occurs in 9 coal fields in the Eocene Wasatch Formation and the Paleocene Fort Union Formation. The alluvium in larger streams has produced several hundred gallons per minute of usable quality water. The Wasatch and Fort Union Formations and underlying Lance Formation and Fox Hills Sandstone contain sandstone layers that produce about 25 gallons per minute of hard water at shallow depths (less than 1,000 feet) near outcrop areas, and industrial size supplies of softer water usually containing 500 to 1,500 milligrams per liter of dissolved solids at depths of 3,000 to 5,000 feet where the water is confined. In deep (below 5,000 feet) parts of the basin, where the Madison Limestone is fractured and cavernous, flows of as much as 7,000 gallons per minute at 179 pounds per square inch flowing pressure have been obtained. Recharge to the Madison Limestone may be as much as 75,250 acre-feet per year from the Big Horn Mountains, the Laramie Range, the Black Hills, and possibly the Hartville uplift, all bounding the basin. The only Madison water analysis showed a total dissolved solids content of 3,726 milligrams per liter. Low level surface mining would modify shallow aquifers and lower shallow water tables in about 18,729 acres (except in the southwest where overburden and coal are above the water table), destroy some wells, reduce spring and nearby streamflow and degrade water quality. High level surface mining of an additional 19,279 acres would have expanded equivalent impacts.

ETSI Coal Slurry Pipeline, eastern Wyoming to Louisiana
BLM, Denver, Colorado
FEIS, 1980

Energy Transportation Systems, Inc., (ETSI) proposed to transport 37.4 million tons of coal per year for fifty years from the Powder River Basin near Gillette, Wyoming, by slurry pipeline to various power plants in Oklahoma, Missouri, Arkansas, and Louisiana. Slurry would require 20,000 acre-feet of water per year to be pumped from the Madison Formation in Niobrara County. A numerical model predicted drawdowns of more than 100 feet would occur in a 3,400-square-mile area around the well field, extending into southwestern South Dakota, affecting some existing Madison water users, including the City of Edgemont, South Dakota. Surface waters would also be affected, including base flow reductions of 1 to 4 cubic feet per second in the Cheyenne River, and Cascade and Hot Springs. Drawdowns of more than 100 feet in the Inyan Kara aquifer would extend over 1,600 square miles. Six water supply alternatives were analyzed. One alternative would purchase part of the required water from the City of Gillette well field, reducing drawdowns around the Niobrara County well field by 30 percent, but extending drawdowns over much of Crook County. Another alternative to develop a well field in Crook County would extend drawdowns of more than 25 feet over 23,600 square miles including adjacent parts of Montana and South Dakota, and 7,800 square miles of the Inyan Kara aquifer. Using Gillette and Crook County well fields would reduce the overall affected area but it would extend further south than if the Crook County well field was used alone. Obtaining the required water, half from the Crook County well field and half from the Niobrara County well field would reduce the extent of 100-foot drawdown in the Madison to 3,700 square miles and 330 square miles in the Inyan Kara. Obtaining water from the Oahe Reservoir in South Dakota would not impact ground or surface waters. Using treated wastewater from South Dakota would not impact ground water but would reduce four South Dakota streams' flow by 1.3 to 12.4 cubic feet per second. Document is supported by Well Field Hydrology, Surface Water Quality, and Ruptures and Spills Technical Reports.

Green River/Hams Fork Regional Coal, Colorado and Wyoming
BLM, Craig, Colorado
FEIS, 1980

This statement analyzes the impacts of leasing as many as 16 tracts of Federal coal beneath 30.2 square miles in a 37,000 square-mile area in northwestern Colorado and south-central Wyoming. The Colorado tracts are in the Yampa and Danforth Hills Coal Fields. The Wyoming tracts are along the east side of the Washakie and Great Divide Basins and in the Hanna Basin. In both states, the tracts are in mountain-bound areas of relatively low relief, consisting of low, rolling hills, broad plains and river valleys, and cuestas, in many places characterized by dip slopes and subdued escarpments. In Colorado, the coal is in the Iles and Williams Fork Formations of the Mesaverde Group, and the Lance Formation, all Upper Cretaceous, and in the Paleocene Fort Union Formation. The Wyoming coals are in upper Cretaceous formations and the Paleocene Fort Union Formation. The region is semiarid, annual precipitation ranging from about 9 inches in Wyoming to as much as 13 inches in parts of the Colorado region. The tracts are drained by ephemeral streams in small watersheds of tributaries to the North Platte River in Wyoming, and the Yampa River in Colorado. Annual runoff from the tracts is about 0.7 inches in Colorado and 0.2 inches in Wyoming. Runoff contains half of the sediment, and two to three times the dissolved solids of nearby mountain streams. In some places, small amounts, less than 10 gallons a minute to wells, of shallow ground water is perched above unsaturated coal layers. In Colorado, the water is of marginal quality for domestic use, and in Wyoming it contains 2,000 to 6,500 milligrams per liter of dissolved solids. Shallow ground water issues in a few springs in Colorado. Impacts to both surface and ground water would be local, relatively minor and generally short lived. Mining following maximum leasing would disturb no more than 0.23 percent in Colorado, and less than 0.05 percent in Wyoming, of the shallow aquifers in their respective watersheds. Alternate water would have to be furnished for 14 shallow wells and 9 springs in Colorado, and 47 small reservoirs, each less than 3 acre-feet, and rapidly filling with sediment.

Hanna Basin Study Site Coal Resource and Surface Mining Potential
Reclamation Evaluation in the Hanna Coal Field, south-central Wyoming
BLM, Denver, Colorado
EMRIA Report No. 2-75

The coal resource of the Hanna Basin study site consists of about 25 percent of the 41.2 thousand tons of identified coal beneath less than 200 feet of overburden in the Hanna Basin. The coal is in the upper Ferris Formation of Paleocene age. The site is drained by ephemeral streams tributary to the

Medicine Bow River to the east. Small amounts of water occur in thin sandstone layers above the coal, and slightly larger amounts are found in fractures in the coal beds. Depth to water ranges from 12 to more than 100 feet depending on topography. Flow is westwardly to the North Platte arm of the Seminoe Reservoir. Total dissolved solids in ground water ranges between 1,000 and 4,000 milligrams per liter, many toxic constituents exceeding EPA recommended standards. Surface mining will necessitate draining the coal below the reservoir level. Reversal of the gradient will increase flow into the mine, increasing the amount of water to be handled. No existing wells will be affected. Proper restoration practices will eliminate increased stream sedimentation.

Hanna South Proposed Project
BLM, Cheyenne, Wyoming
IN: Development of Coal Resources in Southcentral Wyoming, FES, 1978

The proposed Hanna South surface mine of 4,127 acres just south of Hanna, Wyoming, includes 640 acres of Federally owned coal and surface. Mining would disturb 90 public acres and 642 private acres containing four coal beds averaging 41.2 feet in total thickness beneath less than 150 feet of overburden. The coal beds dip 25 to 40 degrees northwesterly into the Hanna Basin. The terrain is gently sloping at the head of northeasterly draining ephemeral draws. Small amounts of confined water occur near the mine, at depths ranging from 26 to 115 feet. Total dissolved solids ranged from 470 milligrams per liter in a shallow, 130-foot-deep well, to 9,160 milligrams per liter in a well 240 feet deep. Annual precipitation of 10 inches produces runoff of 0.5 inch in ephemeral draws. Runoff is high in dissolved solids and sediment. Mining would lower water level in an unused nearby well and destroy one stock reservoir. Water levels would recover by about 1996.

Powder River Regional Coal, Montana and Wyoming
BLM, Casper, Wyoming
FEIS, 1981

Leasing of 14 tracts within the Powder River region of Montana and Wyoming is proposed to all for development of 1.5 billion tons of associated coal reserves. Development of the leases would affect Big Horn, Powder River, and Rosebud Counties in Montana, and Campbell, Converse, Crook, Johnson, Natrona, Sheridan, and Weston Counties in Wyoming. Maintenance tracts to be leased would include the Colstrip A and B, Colstrip C, Colstrip D, Cook Mountain, Coal Creek, Northwest Otter Creek, Timber Creek, Duck Nest Creek, Kintz Creek, and Keeline Tracts. All mined land would be reclaimed. Mining processes would consume 8,310 acre-feet of water, and associated municipal uses would consume 33,400 acre-feet of water in 1990. Approximately 310 wells and 35 springs would be destroyed. Approximately 247,000 acres of shallow aquifers would be removed to depths of 100 to 400 feet, although they would eventually be replaced by spoil aquifers. Surface outflow from the region would be reduced by approximately 350 acre-feet per year during mining. Between 20 and 33 point-watering sources would be destroyed.

Red Rim Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in the Green River Coal Region, south-central Wyoming
BLM, Denver, Colorado
EMRIA Report No. 7-76

The Red Rim study site is above the northwestward dipping sediments of the southern (Red Desert) part of the Great Divide closed Basin. The coal is in the lower part of the Tertiary Fort Union Formation, and overlies a thick sandstone whose outcrop forms the Basin's Red Rim to the southeast. Nearly 40 thousand tons of the estimated coal resource are in beds more than 2.5 feet thick covered by less than 200 feet of overburden. Most of the site is composed of remnants of hogbacks, severely eroded into rolling to rugged high plains. Climate is semiarid. Snowmelt provides 40 percent of the annual precipitation of 10.43 inches. The sites are drained by intermittent Separation Creek and tributaries. Little runoff originates on the site. Little water occurs above and in the coal. Only one of 10 test holes encountered water. Moderate (several hundred gallons per minute) quantities of good quality water may be available from a thick (500-600 feet) sandstone below the coal downdip from the site. Mining should encounter little water. Protective measures and restoration practices could eliminate degradation of water quality.

Sand Butte Preference Right Lease Application, southwestern Wyoming
BLM, Rock Springs, Wyoming
EA, 1981

This document assesses the impacts of an extension of the Black Butte mine in Sweetwater County, about 28 miles east-southeast of Rock Springs, southwestern Wyoming. The 5,078-acre area is a semiarid (annual precipitation 8.8 inches) high plateau, consisting of a series of northeast trending escarpments and 4- to 6-degree dip slopes. About 33 million tons of coal occur in several beds averaging 3.7 to 9.3 feet thick, in the Fort Union and Lance Formations under less than 200 feet of overburden. The area is drained by ephemeral Patrick Draw, tributary to Bitter Creek, several miles northeast. About 60 percent of the surface is bare ground. Small quantities of poor quality water occur in and above the coal beneath drainage ways. No wells exist nearby. It is doubtful that mining would significantly change occurrence of ground water.

Seminole Proposed Project
BLM,
IN: Development of Coal Resources in Southwestern Wyoming, 1978

This document assesses the impacts of approval of a mine and reclamation plan to mine 3,840 acres of coal, 960 of which are Federally leased, about 5 miles west-southwest of Hanna, in south-central Wyoming. Coal is in six seams in the Paleocene/Upper Cretaceous Ferris Formation that dip 20 to 30 degrees northeast to the center of the Hanna Basin. Annual precipitation is 10 inches and annual lake evaporation is 36 to 42 inches. Small amounts of moderately mineralized water is found in thin, discontinuous sandstone, conglomerate and coal layers at depths of 40 to 90 feet. The area drains northeast and southwest to ephemeral streams. The largest drainage area on the site is about 200 acres. Surface water 9.5 miles downstream from the site contained 2,000 to 3,000 milligrams per liter of dissolved solids and 2,170 milligrams per liter suspended solids at low flow, in part from the mine. Mining would lower the water level in one well near the mine and destroy one stock reservoir.

Development of Coal Resources in Southcentral Wyoming
BLM, Cheyenne, Wyoming
FEIS, 1979

Development of Federal coal resources in the 5.5-million-acre southcentral Wyoming region in Sweetwater and Carbon counties, Wyoming, and Routt and Moffat Counties, Colorado, is proposed. Three mining and reclamation plans on existing leases would be approved. Rights-of-way would be issued for 3.4 miles of water pipeline. Anticipated regional activities, including the three proposed leases, would result in an estimated annual production of 17.8 million tons of coal by 1990. Mineral extraction activities would deplete regional coal reserves by 204 million tons by 1990. The topography of 18,760 acres would be disturbed by the proposed lease development, existing mining activity, and the development of oil, gas, uranium, and sand. Demand for industrial and municipal water would increase by 910 acre-feet per year. The quality of postreclamation aquifers would decline and that of surface water would be degraded by the runoff of contaminants resulting from increased population and industry.

Development of Coal Resources in Southwestern Wyoming
BLM, Cheyenne, Wyoming
FES, 1978

This statement assesses impacts of approval of five mine and reclamation plans, 4 surface and one underground, issuance of associated rights-of-way, and cumulative impacts of potential coal development in the region. The five mines would produce 15.2 million tons per year, in addition to the 1990 annual production of 16 million tons of existing and projected mines. Three of the mines are in the Overthrust Belt on the west of the region and two are in the Rock Springs uplift on the east. The region is drained by the Green River and tributaries. The mine areas are on the flanks of the Green River Basin and are drained by ephemeral Green River tributaries. Surface water quality is generally good, ranging from less than 100 to more than 2,000 milligrams per liter dissolved solids, depending on flow. Wells generally yield 10 to 100 gallons per minute of water ranging from 500 to 3,500 milligrams per liter of disolved solids. Water use of 5,040 acre-feet per year due to the proposed action is about 0.035 percent of expected total water use by 1990. Mining would temporarily increase recharge and salinity of ground water near the river, but regional impact would be insignificant. Lower infiltration rates of reclaimed overburden would increase streamflow and sediment load locally.

Proposed Development of Coal Resources in Southwestern Wyoming
BLM, Washington, D.C.
FES, 1978

The statement assesses impacts of five proposed coal mines in Lincoln, Uinta and Sweetwater Counties in southwestern Wyoming, three in the Hams Fork Coal subregion and two in the Green River subregion. The Hams Fork region mines straddle, or are on limbs of the northerly trending Lazeart syncline where dips range from 15 to 50 degrees. Coal is in numerous Adaville Formation beds ranging up to 70 feet thick, covered by less than 1,000 feet of overburden. One Green River region mine area overlies 6 Rock Springs Formation coal beds ranging from 4 to 14 feet thick, overlain by as much as 800 feet of gray sandstone of the Ericson formation. The other mine includes two seams as much as 26 feet thick in the Fort Union and Lance Formations, and the 10- to 12-foot-thick Almond coal seam. There is a total of 357 million tons of coal beneath the five mine areas. Average precipitation in the region is 9.5 inches and ranges from 7.89 inches at Rock Springs to 17.92 inches at Afton. Most of the area is drained by ephemeral drainages. Small quantities of water occur unconfined in outcrop areas in the coal beds, interbedded sandstone layers and fractured shale and mudstone, and confined downdip. Mining in the Hams Fork subregion could affect two springs, and in the Green River subregion, could affect six or more nearby wells. Sedimentation in main drainages could also occur.

White Tail Butte Study Site Coal Resource and Surface Mining Potential Reclamation Evaluation in the Little Powder River Coal Field, northeastern Wyoming
BLM, Denver, Colorado
EMRIA Report No. 13-77

The gently rolling uplands and isolated knobs and buttes of the 3.6-square-mile White Tail Butte study area cover an elongate drainage divide between intermittent Elk and White Tail Creeks. Maximum relief is 350 feet. Precipitation is about 16.3 inches. Three Tongue River Member (Fort Union Formation) coal beds crop out or are covered by less than 200 feet of overburden: the Anderson, averaging 34.3 feet thick; the Dietz, 18 to 28 feet thick; and the Canyon, averaging 21.6 feet thick. Small amounts of water containing about 2,000 milligrams per liter dissolved solids occur in shallow layers above, in and between the coals. Small amounts of less mineralized water occur below the Lebo shale member which lies below the lowest, the Canyon, coal bed. Surface mining will alter shallow aquifers, displace springs, and destroy several stock ponds. Aquifers below the Lebo Shale Member (bottom of the Fort Union Formation) would not be affected.

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Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-542, 1981. 56 p, 4 Fig, 5 Tab, 29 Ref.,
Journal Announcement: SWRA1501
A requirement of Public Law 95-87, the Surface Mining

Control and Reclamation Act of 1977, is the understanding of the hydrology in actual and proposed surface-mined areas. Surface-water data for small specific-sites and for larger areas such as adjacent and general areas are needed also to satisfy the hydrologic requirements of the Act. The Act specifies that surface-water modeling techniques may be used to generate the data and information. The purpose of this report is to describe how this can be achieved for smaller watersheds. This report also characterizes 12 'state-of-the-art' strip-mining assessment models that are to be tested with data from two data-intensive studies involving small watersheds in watersheds with specific-site data. Extending the use of modeling techniques to larger watersheds remains relatively untested, and to date the upper limits for application have not been established. The U.S. Geological Survey is currently collecting regional hydrologic data in the major coal provinces of the United States and this data will be used to help satisfy the 'general-area' data requirements of the Act. This program is reviewed and described in this report. (USGS)

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A Presentation and Evaluation of the Hydrologic information available for the major federal Coal Lands in seven Eastern States--Sources of available information and a plan for future work
Grason, David
U.S. Geological Survey Open-File Report 82-525, 348 p.
The most abundant and available Federal coal reserves in Eastern United States are in and near the National forests. The National forest areas offering the greatest potential for coal development are in or near the Daniel Boone in Kentucky and Tennessee, Hoosier in Indiana, Jefferson in Virginia, Monongahela in West Virginia, Shawnee in Illinois, and Wayne in Ohio. An evaluation of the available data and published information on coal mining and the water resources of these areas identifies informational needs. Three such needs common to all six National forest areas are for (1) numerical characterization of streamflow, water-quality, and sedimentation characteristics; (2)

information about ground-water availability, movement, and quality, before, during and after mining; and (3) a hydrologic reconnaissance of all major lakes and impoundments within the prospective Federal coal-leasing area. Investigations which would address these and other informational needs are outlined for each forest area. A schedule is proposed for completion of these recommended investigations by the U.S. Geological Survey over a 6-year period. The application of sophisticated analytical and interpretive techniques in these studies must be preceded by the collection and preparation of adequate hydrologic data.

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Moore, J. E.
Geological Survey, Reston, VA. Water Resources Div.
Geological Survey Open-File Report 80-581, 1980. 22 p, 11 Ref.,
Journal Announcement: SWRA1411

In the past decade hydrologists have emphasized the development of computer-based mathematical models to aid in the understanding of flow, the transport of solutes, transport of heat, and deformation in the groundwater system. These models have been used to provide information and predictions for water managers. Too frequently, groundwater was neglected in water-resource planning because managers believed that it could not be adequately evaluated in terms of availability, quality, and effect of development on surface water supplies. Now, however, with newly developed digital groundwater models, effects of development can be predicted. Such models have been used to predict hydrologic and quality changes under different stresses. These models have grown in complexity over the last 10 years from simple one-layer flow models to three-dimensional simulations of groundwater flow which may include solute transport, heat transport, effects of land subsidence, and encroachment of salt water. This paper illustrates, through case histories, how predictive groundwater models have provided the information needed for the sound planning and management of water resources in the United

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